Robot Championship 2026

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RULES & REGULATIONS

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1. INTRODUCTION

1.1. General Conditions

1.1.1. The IEEE Robot Championship will be held in Malta on 28th and 29th November.

1.1.2. Only valid applications will be considered to be selected for participation. The deadline for applications is by the end of the day of the 5th April 2026. All the applications must be made using the Google form publicly available. Click here. No later submissions nor submissions done through any other channel(s) will be considered.

1.1.3. There is a limit of twenty (20) teams for this championship, or the number of teams that the available funding can support, whichever is lower. If the total number of eligible applications exceeds this limit, a selection process will be conducted, considering the diversity of sections participating, the team's motivation, and the funding. A number of judges will be chosen to recommend the teams that are invited for the championship according to preestablished criteria.

1.1.4. The hosting country can have up to **four** participating teams per category competing in the championship.

1.1.5. In case of acceptance to participate in the championship, all team members must be physically at the event during its entire duration — no partial participation of any member will be accepted. Furthermore, each team is fully responsible for all the funding (except specific funding obtained from the organising committee). No charging can be done to IEEE or any other event organisers in the future. This is mandatory, and non-complying teams will be penalised. The teams need to pay the registration fee until the established date once the team has been short listed.

1.1.6. Organisers committee may fund applications on a limited type of expenses, such as accommodation expenses. A motivation for this funding must be written in the application form's proposal file. This fund is limited and will be assigned to teams depending on several factors (non-exhaustive list, in a non-relevant order): (1) the income level of the team's country of origin, (2) the resources available at the team's local section level. Clear criteria will be established and defined by the organisation committee.

1.1.7. Every game is governed by a distinct set of rules. It is important to note that rules and judgments made in previous games do not necessarily apply to subsequent games. The decisions made by the judges in each game are definitive and binding.

1.2. Participation Categories

1.2.1. Participants are to apply for these categories:

Category	**Retainer Fee per team**	**Maximum number of members**
Arena 4 Games	€350	3 members
Robot Arm AI Challenge	€250	2 members

1.2.2. **IEEE Arena 4 Games Category:** In this category robots compete against each other in the arena in a series of games whereby the robots are remote controlled by the team.

The arena of **6m by 6m** will be available on site. The arena floor will be made of plywood and have a sticker/design of **about 4m by 4m.** Robots need to be designed to give an **Allowance of 4mm f**loor difference between panels.

1.2.3. The **IEEE Robot Arm AI category** will be introduced as a new category within the IEEE Global Robot Championship Malta 2026. In this category, teams are expected to develop adaptive robotic arm systems capable of

learning tasks directly from human demonstrations using imitation learning techniques.

Unlike classical robotics approaches that rely on remote control, fixed trajectories and/or predefined programming, this challenge will emphasise learning-based control, where robots learn to translate sensory inputs into physical actions.

Robot arms need to be designed to work within a workspace **160cm wide and 80cm** deep.

See respective sections or further details.

1.2.4. Rule Interpretation and Fair Play: Any action not explicitly permitted within these rules shall be considered prohibited. All rules must be followed in accordance with their intent, ensuring fairness and participant safety. Any attempt to misinterpret, bypass, or exploit ambiguities for competitive advantage may result in penalties, including disqualification.

1.3. General Safety

1.3.1. Robots will be inspected for safety, reliability and conformity to these rules and regulations before being allowed to compete.

1.3.2. It is always advisable to consult with the organisers before developing potentially controversial systems. Failing to do so, may result in disqualification and banning from the championship as per organisers decision

1.4. Teams & Robot Classes

1.4.1. Each team participating in the Arena 4 Games Category must consist of up to three (3) members.

1.4.2. Each team participating in the Robot Arm AI Challenge can have up to two (2) team members.

1.4.3. Each team can have up to one (1) mentor who is NOT to be funded through IEEE.

1.4.4. A mentor may support 1 team per category.

1.4.5. No participant can be part of more than one team of the same category.

1.4.6. Only one (1) team member can be participating in both categories i.e. 1 member can be a member of a team **Arena 4 Games Category** and also a team of the **Robot Arm AI Challenge Category.**

1.4.7. Competitors must be current student members of a student branch within Region 8, or past students having finished their studies in the previous scholastic year and still members of the student branch.

1.5. Role of Mentors

Mentors play a vital role in supporting participating teams throughout their preparation for the championship. Their primary responsibility is to ensure the health, safety, and well-being of all team members during project development, testing, and participation in championship activities.

Mentors are expected to guide teams in planning and organising their work, helping participants adopt sound engineering, project management, and problem-solving practices without taking ownership of the design or implementation of the solution. The objective is to enable learning and independent achievement by the participants.

Where teams lack specific technical expertise, mentors should provide appropriate technical guidance to help participants understand concepts, evaluate approaches, and overcome challenges. When specialised knowledge falls outside the mentor's own expertise, mentors are encouraged, where possible, to facilitate connections with relevant subject matter experts who can provide additional guidance and support.

Mentors should foster an inclusive, collaborative, and ethical learning environment that encourages creativity, innovation, teamwork, and continuous learning. While mentors may advise, demonstrate techniques, recommend resources, and review progress, all key design decisions, implementation, programming, fabrication, testing, and competition activities must remain the work of the participants. The championship seeks to recognise the achievements and learning of the students themselves, with mentors acting as facilitators rather than contributors to the final solution.

2. AI Pitch Proposal

2.1.1. Requirement

2.1.1.1. As part of the competition, each team must submit an AI Robot Championships Pitch proposal describing the concept of the robot they intend to develop for either the Arena Robot Competition or the Robot Arm AI Challenge addressing IEEE core mission that is Advancing Technology for Humanity within the four themes chosen.

2.1.1.2. The proposal should clearly outline the problem that is being addressed, the technological idea and demonstrate how the proposed robot and AI solution could advance technology for the benefit of humanity.

2.1.2. Proposal Objectives

The submission must address the following elements:

I. Innovative Idea

Present the problem that is being solved and the concept of the robot, explaining the originality of the proposed technological solution.

II. Review of Current Developments

Provide a brief overview of existing technologies, research, or products related to the proposed idea.

III. Strategy from Idea to Realisation

Describe the proposed approach for transforming the idea into a practical robotic solution, including design considerations, product development and implementation strategy.

IV. Risk Assessment

Identify potential technical, operational, or ethical risks associated with the proposed solution and outline possible mitigation strategies.

2.1.3. Thematic Focus

Teams must align their proposal with one of the following themes:

a) **Assistive Robotics for Healthcare and Wellbeing**
b) **Environmental Sustainability and Climate Action**
c) **Disaster Response and Humanitarian Assistance**
d) **Smart Cities and Future Infrastructure**

2.1.4. Submission Requirements

Teams are required to submit their AI pitch proposal at least one month prior to the competition using the official Google Form that will be shared with all participating teams.

2.1.5. Competition Presentation and Recognition

During the first day of the championship, each team will deliver a demonstration and presentation lasting no more than five minutes. The presentation must include a short video illustrating how the designed robot and AI system contribute to advancing technology for the benefit of humanity.

The AI Robot Championships Pitchideas activities will be recognised.

Further details regarding the format and evaluation criteria will be provided in the final Rules and Regulations of the IEEE Global Robot Championship Malta 2026.

3. STEM Activities

External members, including IEEE Student Branches, academic groups, industry partners, and other supporting organizations, are encouraged to propose and deliver STEM activities as part of the championship program. These activities should be designed to enrich the overall event experience, promote learning and engagement, and create additional opportunities for participants, students, and visitors to interact with robotics, engineering, and related technologies.

The objectives of these STEM activities are to:

- broaden the educational value of the championship
- promote interest in robotics, engineering, AI, and technology among students and the wider community
- provide hands-on, inspiring, and accessible learning experiences
- strengthen collaboration between teams, Student Branches, educational institutions, and industry supporters
- increase outreach and public engagement around the event

The intended audience for these activities includes:

- participating teams and their support members
- school students and university students
- IEEE Student Branch members
- educators and mentors
- event visitors and the general public with an interest in STEM

The inclusion of STEM activities is encouraged as an optional contribution to the championship program and is not mandatory.

Any external member or supporting organization proposing a STEM activity shall be responsible for funding and resourcing that activity in full. This includes any costs related to materials, equipment, logistics, staffing, setup, operation, and dismantling.

4. ARENA 4 Games Category

4.1. General Construction

4.1.1. A maximum voltage of 24V DC is allowed for powering the robot's drive and add-on systems.

4.1.2. The fitting of interchangeable body panels or alternative add-ons is allowed between games.

4.1.3. Any onboard equipment that could require maintenance between games, such as the recharging of compressed gas cylinders or batteries, should be easily and quickly accessible. The robot should be fully serviceable within a reasonable amount of time to participate in the planned competitions.

4.1.4. All compressed gas cylinders must be controlled. Such cylinders, provided by the competitors, will be stored at room temperature, then tested and vented if necessary to **1000 psi**.

4.1.5. Each robot must have a number of **active** and **effective** add-ons within the rules of the competition.

4.1.6. An active add-on is defined as an actuated device intended to enhance the robot, in addition to or independent of the robot train drive such as Flipper, Spinner, Lifters etc.

4.1.7. An effective add-on is one which effectively enhances the capabilities of the robot such as fixed ramps, tow bars, fork bars etc.

4.1.8. The use of automated tools to enhance a robot's performance is allowed, provided that safety measures including emergency stops are implemented. Additionally, a manual control system should be

incorporated to enable human intervention when necessary.

4.1.9. Essential spare parts must be made available on the day of the competition.

4.2. Build & Function

4.2.1. Robots can be built using wheels, tracks or legs ("walkers"). No flying robots (or parts of them) will be accepted in the championship (e.g., drones are not allowed).

4.2.2. Other styles and methods may be considered, but participants are required to contact the organisers before commencing construction.

4.2.3. "Cluster Bots", i.e., robots consisting of two or more components, are allowed. They must enter the arena as a single object, and if 50% or more of the robot is immobilised, the robot will be deemed to have lost that particular game.

4.2.4. In the event a participating robot ceases to function during the game, a predetermined time frame will be allocated for rectification. Should the robot fail to resume functionality within this allotted time, the game will be declared null. Consequently, the runner-up in the competition will be given the opportunity to replace the non-functioning robot.

4.3. Weight & Dimensions

4.3.1. Every team will participate in the Featherweight category where each robot is allowed to weigh up to 20 kg.

4.3.2. If interchangeable add-ons are used, the final weight is measured with the heaviest setup.

4.3.3. The base/floor dimensions (length x breadth) of the robot must not exceed 80cm x 80cm.

4.3.4. After every game the robot is expected to be able to retract itself to its initial status/position/setup (including dimensions), if these have been altered during the game. Failure to do so will result in the robot losing the match.

4.3.5. There is a vertical maximum height restriction of 50 centimetres.

4.4. Motive Power

4.4.1. GENERAL

4.4.1.1. Motive power for the drive and/or add-ons may be electric, hydraulic or pneumatic.

4.4.1.2. A combination of engines, such as electric drives, pneumatic and/or hydraulic pumps is allowed.

4.4.1.3. Other types of engines may be considered, but participants are required to contact the organisers prior to construction.

4.4.2. SAFETY

4.4.2.1. Proper activation and deactivation of robots is critical. Robots must only be activated in the arena, testing areas, or with the express consent of the event organisers or the safety officials.

4.4.2.2. All robots must be fitted with a cut-off/kill switch which fully deactivates all of the robot's subsystems, including drive, add-ons and communications, in less than sixty (60) seconds by a manual

disconnect. If there is more than one isolating switch, these must be positioned adjacent to one another.

4.4.2.3. The kill switch must be positioned in a visible part of the robot's bodywork and away from any operating add-ons or drive. This position must be clearly marked and accessible at all times.

4.4.2.4. The switch/link may be fitted under a cover, provided that the cover can be quickly opened without the use of tools and is clearly marked.

4.4.2.5. If the proposed robot design might fail to conform to any safety regulations, contact the organisers before commencing any work.

4.4.3. ELECTRIC

4.4.3.1. The maximum voltage is as defined in Section 3. The utilised voltage must be declared on the technical check sheet before the tournament commences.

4.4.3.2. All power connections, i.e. connections carrying a heavy current, must be of an adequate grade and be properly insulated. Cables must be routed to minimise the chances of being cut.

4.4.3.3. Batteries must be completely sealed and not contain free-flowing liquid, whether electrolyte or otherwise.

4.4.3.4. Battery connections must be adequately insulated.

4.4.4. HYDRAULIC

4.4.4.1. Hydraulic pressure is limited to 3000 psi. The competitor must be able to demonstrate the pressure used and carry with them a

portable pressure gauge that can be fitted to the system if required to do so by the organising team.

4.4.4.2. The use of accumulators on the hydraulic circuits is strictly prohibited.

4.4.4.3. Hydraulic fluid storage tanks must be of a suitable material.

4.4.4.4. Hydraulic fluid lines and fittings must conform to British Standards (BS) specifications. The lines must be routed to minimise the chances of being cut.

4.4.5. PNEUMATIC

4.4.5.1. Pneumatic pressure is limited to 1000 psi. The competitor must be able to demonstrate the pressure used and carry with them a portable pressure gauge that can be fitted to the system if required to do so by the organising team.

4.4.5.2. Compressed gas cylinders must conform to current HSE specifications only. Only the following cylinders, or multiples thereof, are allowed.

Capacity (kg)	**Material**
1.1	Steel
1.1	Aluminium
2.0	Aluminium

4.4.5.3. These compressed gas cylinders must have been examined by a competent person in the past five years and have a valid test certificate, stamped with the date of the test and the brand of the person who carried out the inspection.

If, upon inspection, we deem that the construction or valve has

been altered or tampered with in any way, the robot will be disqualified. Valves must be fitted using the torque values specified in **BS 5430**.

4.4.5.4. Pneumatic lines and fittings must conform to BS EN983 or ISO4414. The lines must be routed to minimise the chances of being cut.

4.4.5.5. All gases in pneumatic systems must be inert. Examples include carbon dioxide (CO_2), argon (Ar) and nitrogen (N_2).

4.4.5.6. CO_2 can only be considered inert when dry, hence under no circumstances must moisture be allowed to enter a CO_2 cylinder except under the supervision of a competent person with knowledge of the correct drying procedures.

4.5. SAFETY

4.5.1. All compressed gas cylinders and valves/regulators must be contained within the body of the robot to shield them from punctures.

4.5.2. The compressed gas cylinder must be securely fastened down. Unless adequately protected by the bodywork, the valve/regulator must have an adequate strap or cage over it.

4.5.3. A pressure relief/safety valve must be fitted on the high pressure side of the circuit and set to lift at 1000 psi. CO2 cylinders must also be protected by a burst disc, set to rupture if the pressure within the cylinder reaches 2700 psi/190 bars.

4.6. ADD-ONS

4.6.1. All pyrotechnics, explosives, flames, firearms, liquids, corrosives and electronic devices such as radio jammers and heat guns are strictly prohibited.

4.6.2. Devices using inflammable or combustion-supporting gases are prohibited.

4.6.3. Untethered projectiles are not allowed.

4.6.4. If tethered projectiles are used, the tether may not exceed one point **1.5 m** in length. This is measured from the centre of the robot to the tip of the projectile.

4.6.5. Rotating hardened steel blades that may shatter are not allowed. **Discuss the blade grade with the organising committee prior to installation.**

4.6.6. Any blades, such as bayonets, must not exceed **15 cm** in length.

4.6.7. Adequate protection must be fitted at all times on any add-ons with sharp edges and other hazardous parts of the robot(s) except when the robot is in the arena. This protection would not be considered as part of the final overall weight of the robot.

4.6.8. Any moving or swinging arms, regardless of whether they hold sharp and/or rotating add-ons, must be fitted with a visible **locking pin** to show that the arm(s) is/are securely locked in place.

Locking pins must be painted **red** or have a **red tag** attached and must be in place at all times, except in the arena. These locking pins do not contribute to the overall weight of the robot.

4.6.9. Self-contained add-ons must have a secondary restraint fitted in the event of the primary fitting breaking away.

4.6.10. Autonomous add-ons are allowed, although strict safety procedures must be incorporated. Discussing such designs with the organisers is strongly recommended.

4.7. Radio Control

4.7.1. All robots must be controlled wirelessly from outside the arena.

4.7.2. All the RC circuits, which can either be purchased or built, must have its frequency declared.

In order to do this, all registered competitors will be invited to join a Google / Facebook group named **"IEEE R8 Robot Championship 2026"** after the final registration deadline to communicate this information to all participants.

It is up to each team to ensure that there are no duplicate frequencies. Teams are encouraged to use 2.4 or 5.0 GHz technology rather than FM in order to avoid interference with other teams' radios and external sources.

4.7.3. Frequencies are allocated on a first come first served basis.

4.7.4. You may use any wireless control system that you believe will work best, provided it is reliable and does not interfere with other robots

4.8. Championship Structure

4.8.1. [Registration for this category is 350Euro retainer per team. Maximum 3 members]

4.8.2. The championship structure will be defined once the number of competitors is finalised. This ensures that an adequate competition

structure is chosen for the number of teams. The following structure is a sample and the organisers can change how the games are played depending on the robots that manage to come to Malta to compete.

4.8.3. The championship is first divided into two major parts:

- **Qualifying phase**
- **Knockout phase**

4.8.4. For the first Game, the matchups are randomly pre determined by the organising committee with the sole condition that no team from the same country is matched up against the other. The matchups will be revealed on the day.

4.8.5. Qualifying Phase

4.8.5.1. The Qualifying phase will involve:

- Round-1: "**Time of Fall**"
- Round-2: "**Climate CHAOS**"
- Round-3: "**Weight in line**"

4.8.5.2. Qualifier Round-1 "Time of Fall" will determine the ranking for the next round (details of "Time of Fall"). The Winner with the shortest game time ranks first, followed by the second shortest winner time. After all winners are ranked, losers are ranked with longest game time followed by the second longest game time. Disqualified players do not earn any qualifying points.

4.8.5.3. Qualifier Round-2 "Climate CHAOS" is the second qualifying game. The matchups will be determined based on the performance in the 1st qualifier round. The robots will be paired with 1st Place Rnd1 Qualifier Vs Last Place Rnd1 Qualifier. 2nd Place Rnd1 Qualifier Vs 2nd Last Rnd1 Qualifier and so on.

4.8.5.4. Qualifier Round-3 "Weight in line" is the third qualifying game. The matchups will be determined according to the points scored during the previous round.

4.8.5.5. Tie breaker. In the case of a tie/s where teams score equal points to each other, the ranking from Round1 is to be used as a tiebreaker.

4.8.6. Knockout Phase

4.8.6.1. The First 8 Qualifiers pass through to the knockout phase.

4.8.6.2. The Knockout phase will involve:

- “Weight in line”
- “Hanging Hazard”

4.8.6.3. The matchups for the knockout phase will be determined based on the total points gained in the weight in line game. The robots will be ordered from best to worst and matched as such.

E.g., 1st Place qualifier Vs Last place Qualifier. 2nd Place Qualifier Vs 2nd Last Qualifier and so on.

4.8.6.4. Any robots that have previously competed against each other will not be paired for subsequent matches. Instead, they will be matched against the competitor with the least favourable performance among the remaining participants, commonly referred to as the 'worst runner-up'

4.8.6.5. The Knockout phase starts with the “Weight in line.” For every match, one winner will be drawn and moves on to the next game.

4.8.6.6. The semi final game is a 2nd game of “Weight in line”. Its winners will move on to the final match. The losers will be matched to compete for the 3rd place.

- The runner up game is “**Hanging Hazard**”. Its winner will be awarded 3rd place, and the loser the 4th.
- The final game is “**Hanging Hazard**”. Its winner will be awarded 1st place, and the loser the 2nd.

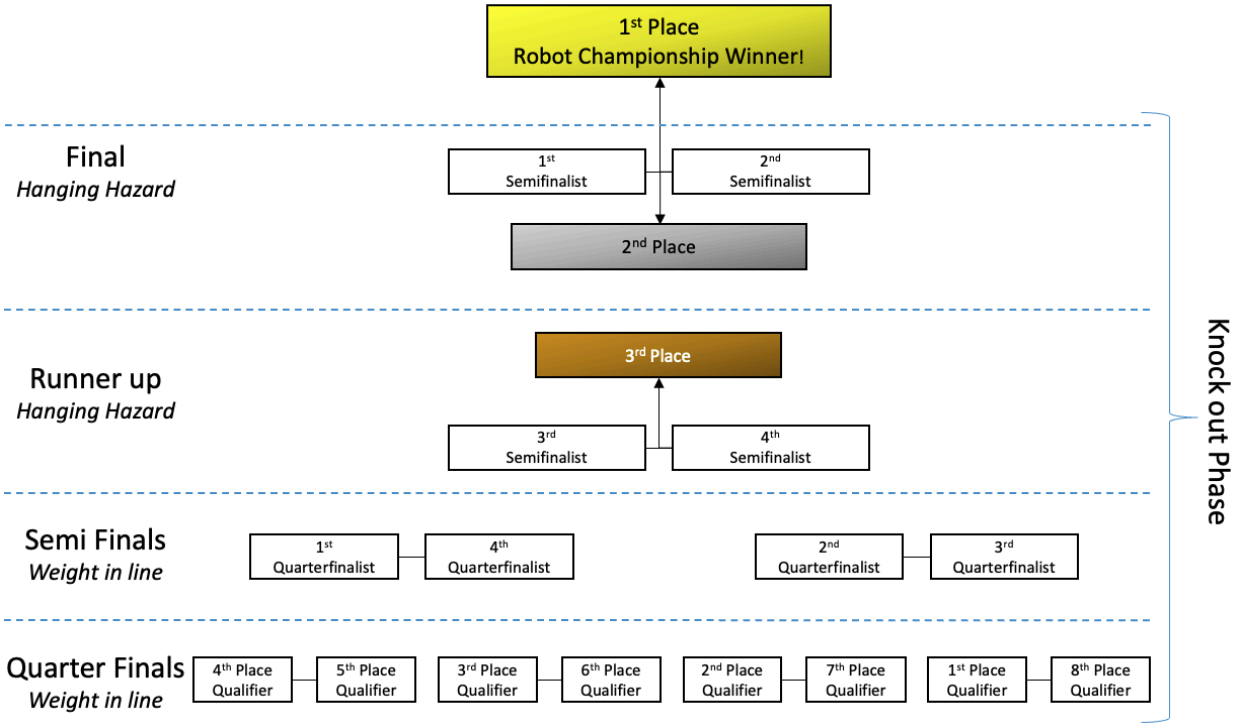
4.8.7. Championship Structure Illustration

4.8.7.1. An illustration for the Championship Structure is presented in Figure 1.

(Note as pointed out in 9.1, the Championship Structure can be subject to change to **adjust to the number of** participants available to participate on the day).

4.8.7.2. The timings and end conditions of each game are described in Section 14.

4.8.7.3. For every game, no competitor is allowed to touch/modify the respective robot until the end of that game.



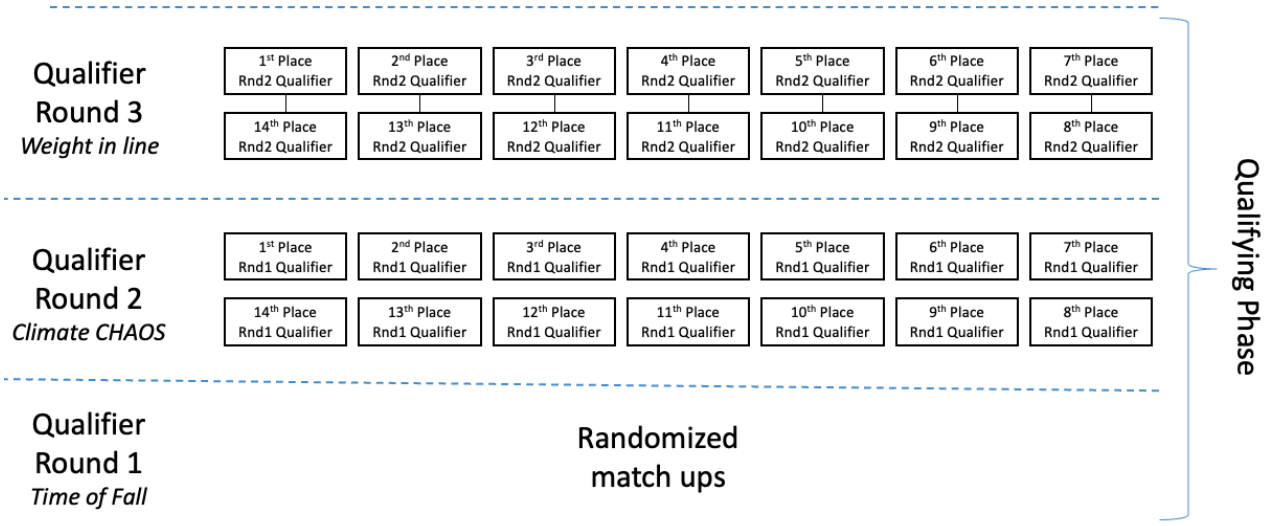


Figure 1 - Illustration for the Championship Structure ONLY for guidance depending on the robots that can participate in the championship.

4.9. Arena 4 GAME TYPES

4.9.1. Game 1: Time of Fall

4.9.1.1. This game will be used to qualify robots for the Knockout phase of the championship.

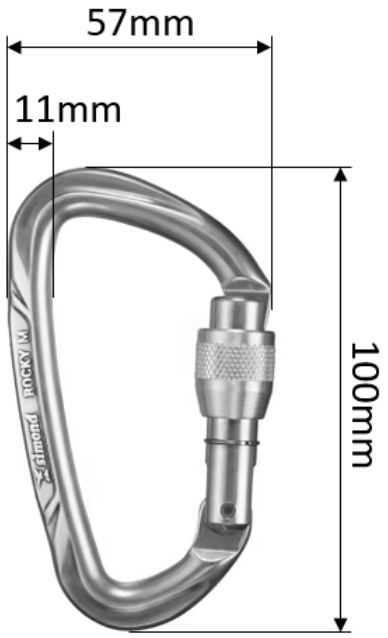
4.9.1.2. The robots winning one match stand a higher chance to be qualified.

4.9.1.3. **OBJECTIVE**: To pull the opponent off the edge at the shortest time possible.

Rules

4.9.2. Players start the game connected to each other via a chain with connectors at each end for each player and equidistant from a pit/fall.

4.9.3. Image of connector to be used during this game:



Diameter of connector material is 11mm with the gate opening up to 17mm.

Imp. In case a player's tow point does not fit the connector, that player is disqualified for this game.

4.9.4. When the game starts, a timer begins. Both players need to try to pull their opponents off over the edge. The player that succeeds wins the match.

4.9.5. As soon as a player falls, the timer stops.

- No add-ons (cf. Section 3.5.1) are allowed to be used in this game.

4.9.6. The game ends whenever one of these criteria is met:

- 1st priority: Whenever a player manages to pull the opponent off the edge, or
- 2nd priority: after 60 seconds of game time.

4.9.7. In the case where the game ends after the game time is over (2nd priority) and none of the players falls off the edge, the distance from the edge of the pit to the tow point is measured. The player with the longest distance counts as the winner of the match. (Imp. a winner of this type ranks lower than any winner which pulls their opponent off the edge. Vice versa, a loser of this type ranks higher than players who fall off the edge).

4.9.8. In case of multiple winners via 2nd priority, such winners are ranked between themselves starting from the winner with the longest distance followed by losers with the longest distance.

4.9.9. In cases where a player's tow point breaks (the part intrinsic to the robot required to fix the chain connector) that player is disqualified and automatically loses the game. The opponent will count as having a 1st priority win using the time when the tow point broke for ranking purposes.

4.9.10. In case the chain or connectors break (although highly unlikely) a rematch will take place using a spare chain and connectors.

4.10. Game 2: Climate CHAOS

Motivation

4.10.1. The Climate Change Maze aims to draw attention to the consequences of climate change. This maze represents a collapsed building in the aftermath of a climate disaster, highlighting the urgent need for environmental action. Teams will navigate their ground-based robots through the intricate maze, symbolising the challenges humanity faces in a world affected by climate change.

Description

4.10.2. The Climate CHAOS Maze is a thought-provoking competition designed to raise awareness about the impact of climate change. Teams will guide their remote-controlled ground robots through a challenging maze that simulates the environment of a city with sinkholes, flooding and a forest fire growing closer.

Rules

4.10.3. The Maze:The maze represents a small part of a city surrounded with different environmental catastrophes.

4.10.4. Teams must navigate their robots from a designated safe zone to three towers and rescue survivors.

4.10.5. The organisers may introduce unexpected obstacles, challenges, or arena features that teams must identify and overcome during the competition.

Environmental Challenges

4.10.6. Challenges within the maze mimic the effects of climate change, such as flooding, sinkholes and forest fires..

Scoring System

4.10.7. Teams are scored based on the time taken to successfully complete the maze and the number of simulated "survivors" (represented by objects) rescued along the route.

4.10.8. Completion time and the number of survivors saved contribute to the final score.

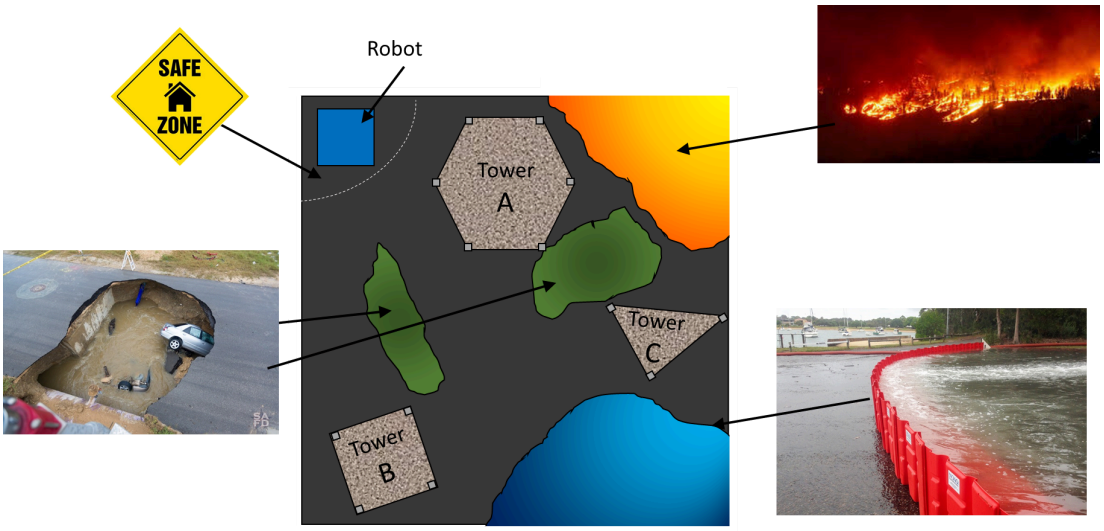
4.10.9. The team with the highest score, achieved by saving survivors in the shortest time, wins.

4.10.10. If the robot oversteps into a flood area it causes a washout. A washout stops the game.

4.10.11. If a washout occurs, it is recorded as the end game condition. Note, two teams with the same points scored but one of them has a washout, the one with the washout ranks lower than the one without.

Infrastructure Needed

4.10.12. Maze Structure is represented in the image below:



(only for reference)

Ground Vehicles

4.10.13. Teams must provide their own ground-based remote-controlled vehicles capable of navigating through the challenging terrain of the maze.

Control Stations

4.10.14. Each team requires a control station equipped with remote control systems and/or a display screen for the robot operator to navigate the robot.

Event Organisers

4.10.15. Trained event personnel responsible for overseeing the competition, ensuring adherence to rules, and tracking completion times and survivor rescues.

Scoring System

4.10.16. The team to retrieve all objects in the shortest time without any penalties will get the best ranking. Teams score points by retrieving the objects under the towers but lose points by collapsing towers and hitting other obstacles.

Game length

4.10.17. The game must be completed within 5 minutes.

Table

4.10.18. The championship will feature three towers, each varying in complexity and characterised by differing numbers of supports, specifically 3, 4, or 5. Underneath each tower, metal cutouts representing individuals and pets will be placed, with one cutout per tower.

4.10.19. The competition scenario includes three simulated climate disasters: sinkholes, forest fires, and flooding. The forest fire challenge incorporates a visual timer, which escalates in intensity as the competition progresses towards the final tower.

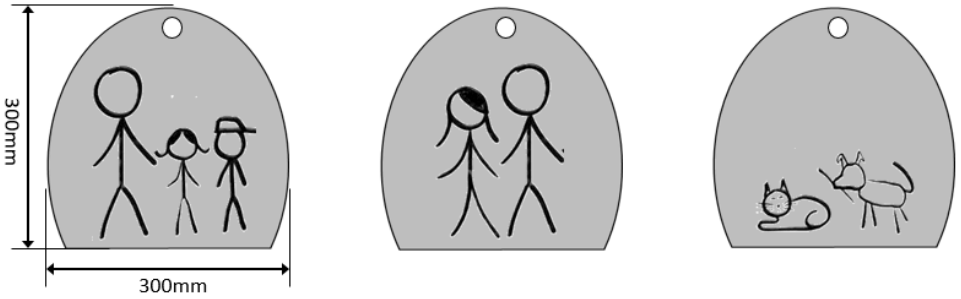
Tower Configuration

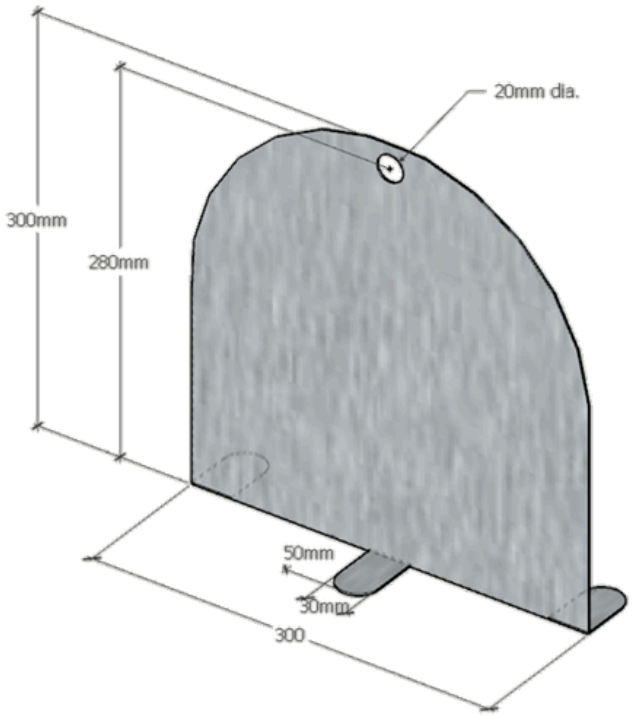
4.10.20. Three towers present, each with a distinct level of difficulty.

4.10.21. Towers will have either 3, 4, or 5 supports.

4.10.22. Metal Cutouts:(Subject to change depending on design feasibility)

4.10.23. Each tower will feature metal cutouts representing people and pets:





4.10.24. Placement: One cutout per tower.

Simulated Climate Disasters

4.10.25. The championship includes three types: sinkholes, forest fires, and flooding.

Forest Fire Challenge

4.10.26. Incorporates a visual timer.

4.10.27. Intensity of fire, that is the timer of fire moving increases as the competition advances towards the final tower.

Flooding Scenario

4.10.28. Pathways obstructed by various objects, including vehicles.

4.10.29. Robots are required to navigate without colliding with these objects.

4.10.30. Towers:

- Tower A Ground clearance of 60cm with 5 Columns
- Tower B Ground clearance of 60cm with 4 Columns
- Tower C Ground clearance of 60cm with 3 Columns

Tower	**Ground Clearance (cm)**	**Number of Columns**	**Points**	**Width**
Tower A	60	5	+50 (-25 if tower collapses)	Approx 900mm
Tower B	60	4	+100 (-50 if tower collapses)	Approx 900mm
Tower C	60	3	+150 (-100 if tower collapses)	Approx 900mm

Map

<u>To be revealed on the day of the event.</u>

4.11. Game 3: Weight in line

4.11.1. **OBJECTIVE**: A red/blue player scores red/blue weights, respectively, by positioning them in their respective positions outlined by a ring.

Image of weights

4.11.2. POINTS and WEIGHT Details:

Weight (kg)	Weight dimensions			Points value
	Inner Diameter (mm)	Diameter (mm)	Height (mm)	
0.5	28	100	13	5
1.0	28	140	13	10
2.0	28	176	18	15
5.0	28	235	25	20
5.0	28	235	25	20
10.0	28	300	30	30
If player's opponent falls into opponent's pit				50
If player's opponent falls into player's pit				100

Rules

4.11.3. Both players start the game in their respective colour corners.

4.11.4. Pushing/minor physical contact with the opponent is allowed.

4.11.5. The usage of active add-ons are ONLY allowed to be used on the weights.

4.11.6. If a player scores the opposing player's weights in their corner, those points will be considered negative points.

E.g., the blue player has already earned 20 points but then dragged the 5 points red weight in their blue corner — now the blue player has 15 points (20 - 5).

4.11.7. If a player manages to score ALL the available weights in time (refer to point 14.2.3.8 below), they can move on to attempt to drop their opponent in their pit for 100 points or in the opposing pit for

50 points, and the game ends. Note, even for this phase, the use of active add-ons on the opponent is NOT allowed.

E.g., the blue player scores all the blue weights. If there is still available time, the blue player can attempt to push the red player into the blue pit for 100 points or into the red pit for 50 points.

4.11.8. If a player drops their opponent in any pit before scoring all their available points first, that player loses the game scoring 0 additional points, and the dropped opponent scores 100 points. Then the game ends.

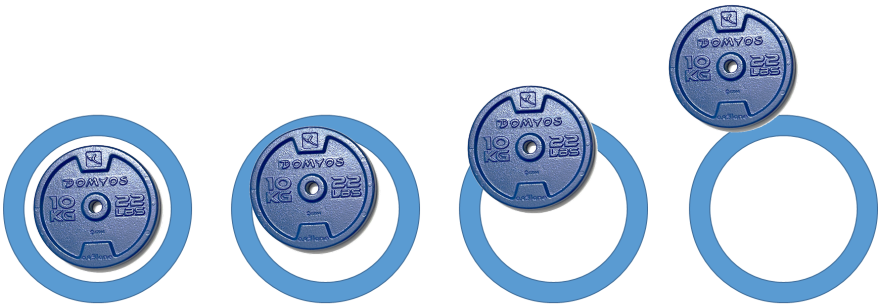
4.11.9. If a robot falls in any pit on their own, the opponent scores the number of points depending on which pit that robot fell into. If it falls in the player's own pit, the opponent scores 50 points. If it falls in the opponent's pit, the opponent scores 100 points. In both cases the game ends.

4.11.10. The game ends either after one of the players falls into the pit, or after 5 minutes since the start. The player with the most points scored wins the match (Note: this also applies even if a player is illegally pushed into a pit as stated in point 14.2.3.6).

4.11.11. Added rules related to the points according to the position of weight in the circle.

Score value;

1) If weight is located fully within its designated location - 100% of points awarded.
2) If weight is located within its designated location but touches the locating circle - 75% of points are awarded.
3) If weight touches both the outside and Inside of the designated location - 50% of points are awarded.
4) If weight does not touch the inside of the designated location - No points are awarded.



1). 100% of Points 2). 75% of Points 3). 50% of Points 4). No Points

Rough Play Penalties

4.11.12. In case of a foul a horn blows to pause the game. Players pause and pay attention to the judges. The judges will point to the fouling corner and show a YELLOW or a RED card.

4.11.13. With a YELLOW card, 10 points are deducted from the fouling player's score.

4.11.14. With a RED card, the fouling player stops playing scoring 0 additional points and the fouled opponent receives 100 points to their score.

4.11.15. If a player already had 2 YELLOW cards in the same match, the next foul will result in a RED card.

4.11.16. If a foul is considered too severe by the judges, a RED card can be given even if the player has no YELLOW cards.

4.11.17. In case of a RED card, the fouled player can continue scoring their weights as the game is resumed.

Note: In this scenario, the player with the RED card is not to be pushed or scored as the 100 pts are already awarded to the fouled player.

4.12. Game 4: HANGING HAZARD

OBJECTIVE

4.12.1. To score Rugby Footballs and/or render the opponent immobile

RULES

4.12.2. Both players start the game in their respective colour corners (Blue or Red)

4.12.3. The game starts with three Rugby Footballs placed in the arena.

4.12.4. Image and details of Rugby Football to be used:

4.12.5. Details: KIPSTA, AF500, Official size, Rugby ball.

4.12.6. Approximate dimensions:

- Length: 280mm
- Width: 155mm

4.12.7. There will be a number of hanging weights above the arena which will be lowered close to the floor before the game starts. These act as an arena hazard for both robots.

4.12.8. All effective and active add-ons (cf. Section 3.5) are allowed in this game.

4.12.9. The corner pits are both replaced with pockets for this game.

4.12.10. The game ends whenever one of these criteria is met:

- 8 minutes of game time. Player with the most scores wins the game.
- If a player is rendered immobile or knocked out. That player loses rendering their opponent as the winner of the game.

4.12.11. In case of a tie, i.e. even number of scores and both players still active and mobile, a judges decision will be put into play.

4.12.12. A player scores by dropping a rugby ball in the OPPONENT's pocket colour. i.e The blue player scores by dropping a rugby ball in the red pocket.

4.12.13. The organisers may introduce unexpected obstacles, challenges, or arena features that teams must identify and overcome during the competition.

4.12.14. A robot is rendered immobile/knocked out when its driver is no longer able to control it.

Examples inc but not limited to: having the driving mechanisms damaged resulting in loss in mobility. Batteries running out. being flipped upside down or on the side losing contact between the

driving system and the ground etc.

Note: In the course of the championship, a contestant is permitted to immobilise their opponent in a locked position for a duration not exceeding 10 seconds. Subsequent to this period, the contestant is obliged to release their opponent from the locked state. Repeated instances of a robot consistently locking its opponent may be considered as a significant factor in the event of a judge's decision being necessary to ascertain the winner.

5. ROBOT ARM AI CHALLENGE Category

[Registration for this category is 250Euro retainer per team. Maximum 2 members]

The **Robot Arm AI Challenge**, a new category within the IEEE Robot Championship introduced in the 2026 edition, signals a major evolution in competitive robotics: a move beyond both classical pre-programmed robotics and purely remote-controlled operation toward the emerging field of **Physical AI**.

At its core, the challenge is about building robotic systems that are not merely scripted or directly driven by a human operator, but **adaptive, trainable, and capable of learning from experience**. Competitors must develop versatile robotic manipulators that use **end-to-end learning** to transform raw sensory input directly into meaningful physical actions.

This stands in contrast to traditional robotics approaches, which often depend on predefined trajectories, manually engineered behaviours, explicit analytical models such as inverse kinematics, or direct operator control through teleoperation. In the **IEEE Robot Arm AI Challenge**, the focus shifts to **learning-based autonomy**, where teams teach robots through **imitation learning**, enabling them to acquire skills from human demonstrations rather than through hand-coded rules or continuous manual control.

The **Robot Arm AI Challenge** is designed to make advanced embodied AI research accessible, competitive, and reproducible for the next generation of roboticists.

*The rules and regulations apply from previous editions of the IEEE Global Robot Championships - Malta. Teams can be made of 2 and only 1 member can be a member of both teams for both categories (Arena 4 Challenge & Robot Arm AI Challenge).

DISCLAIMER : Kindly note that this is a newly introduced Challenge Category and the rules and regulations are subject to change. The judges can decide on changes to the allotted timing for each game.

5.1. General Construction

5.1.1. Robot Arm

5.1.1.1. To ensure fairness, accessibility, and reproducibility, the challenge is grounded in hardware standardisation. All teams will work with affordable, open-source robotic manipulators derived from the SO-100 / SO-101 platforms.

- **Open-source and low-cost**: It is an open-source, low-cost robotic arm solution from TheRobotStudio (https://github.com/TheRobotStudio/SO-ARM100)

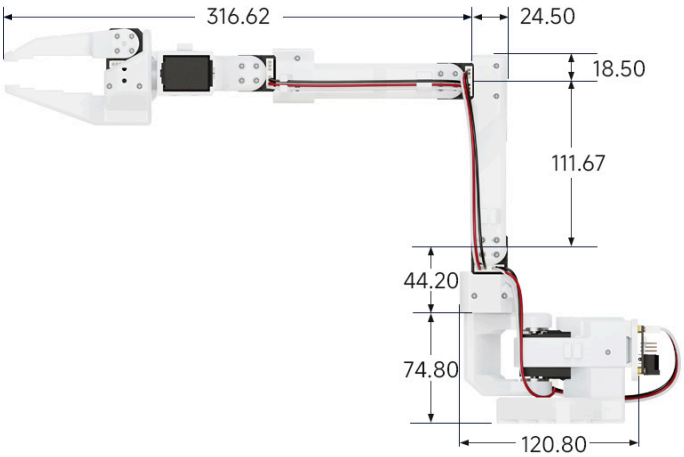
- **Integration with LeRobot**: Designed for integration with LeRobot platform (https://huggingface.co/docs/lerobot/index)

- **Abundant learning resources**: Provides comprehensive open-source learning resources like assembly and calibration guides, and tutorials for testing, data collection, training and deployment to assist users in quickly getting started and developing robotic applications.

- **Multi-Scene Application**: It is applicable to fields such as education, scientific research, automated production, and robotics, helping users achieve efficient and precise robot operations in various complex tasks.

These arms are fully 3D-printable and built using readily available servos and microcontrollers, creating a common hardware foundation while still enabling innovation through perception, learning strategy, coordination, and approved physical enhancements.

5.1.1.2. The robot arm used by the team must be based on the approved SO-100 / SO-101 family or other officially approved baseline variants.



General Dimensions of SO-100/101 robot arm family

5.1.1.3. Two robot arms will be required for this challenge. This is further described in the **Configuration** section. Both robot arms must be the same.

5.1.1.4. Teams must build their own robot arms. Only robot arms that are assembled and constructed by the team shall be considered. Commercial off-the-shelf ready built robot arm systems are <u>not allowed</u> and will be automatically disqualified.

5.1.1.5. The team may purchase a kit for self assembly or construct an equivalent using pre-defined or equivalent 3D printed components, aluminum components, actuators, control systems, sensors and microcontrollers.

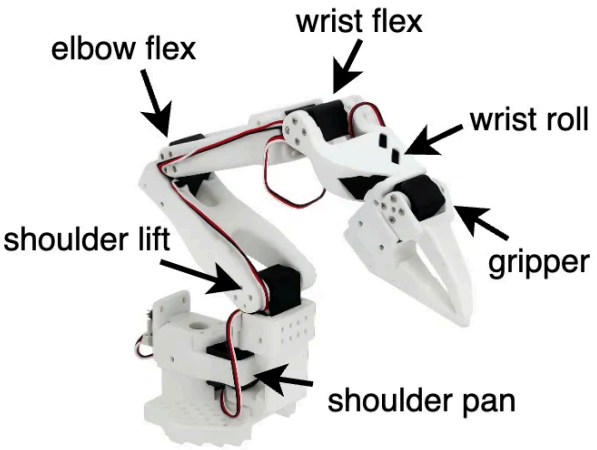
5.1.1.6. If a team desires to use an alternative construction to the proposed hardware standard a request must be submitted to the organising committee for pre-approval.

5.1.1.7. If alternative robot arm design is approved by the organising committee, the team is still bound to all the regulations outlined in this document and such an approval does not imply an exception from any of the regulations.

5.1.1.8. Each robot arm shall provide five active rotational joints corresponding functionally to base rotation, shoulder lift, elbow flexion, wrist flexion, and wrist roll, together with one gripper actuation axis.

Accordingly, each arm comprises **5 DOF (degrees of freedom) for arm motion, and a gripper**.

- Base / Shoulder Pan
- Shoulder Lift
- Elbow Flex
- Wrist Flex
- Wrist Roll
- Gripper



Arm joints

5.1.1.9. The arm shall retain the essential kinematic arrangement, joint order, and functional motion characteristics of the approved SO-100 / SO-101 platform or other officially approved equivalent.

5.1.1.10. Teams can choose their preferred material and colour for the robot arm.

5.1.1.11. There are no weight restrictions for the robot arm.

5.1.2. Gripper

5.1.2.1. The robot shall use either the standard competition gripper or an approved derivative.

5.1.2.2. Custom contact pads, fingertip surfaces, and passive/active finger geometry modifications are permitted.

5.1.2.3. Any custom gripper design shall be declared ahead of the competition and is subject to technical inspection by the organisers and shall remain subject to all other applicable rules relating to safety, dimensions, weight, and non-interference.

5.1.2.4. Any custom gripper shall not damage or alter the workbench or objects used during the competition.

5.1.3. Configuration (Layout)

5.1.3.1. Each competition entry shall use a dual-arm robotic configuration composed of two eligible robot arms.

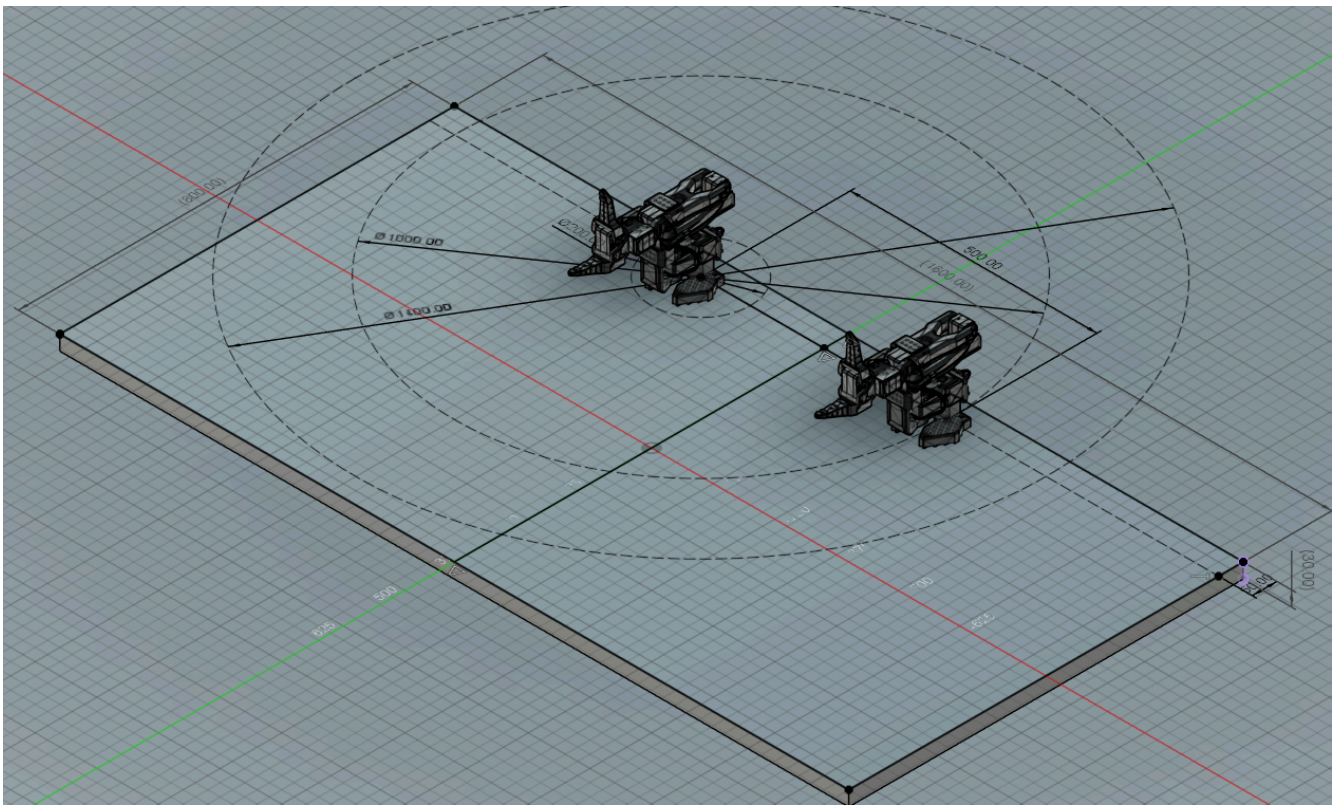


Illustration of workspace (Isometric View)

5.1.3.2. Each robot arm will have its own independent base i.e. the arms are not physically joined.

5.1.3.3. The **nominal horizontal separation between the base centre of the left robot arm base and the base centre of the right robot arm base** shall be **500 mm (A)**, measured centre-to-centre.

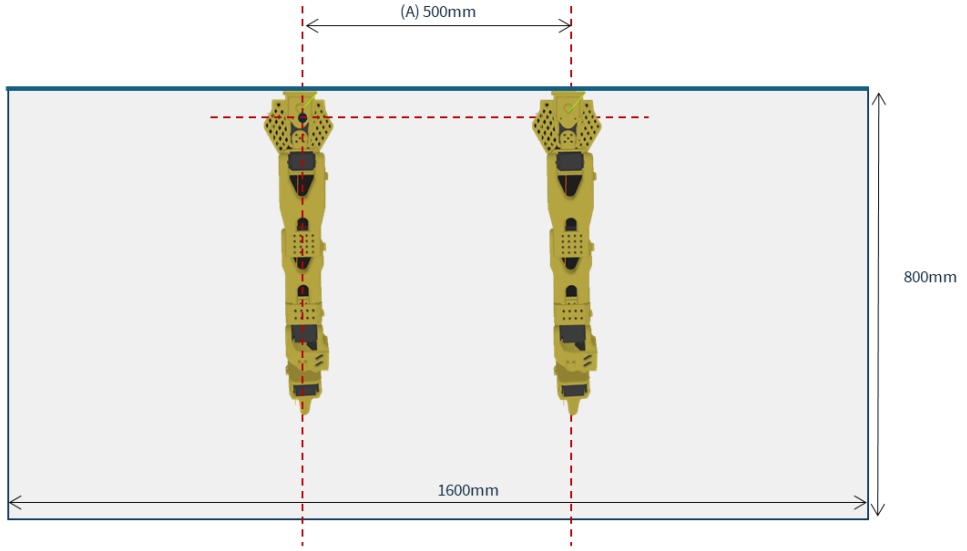


Table workspace showing two robot arms from the top with distance between them

5.1.3.4. For the purpose of measurement, the **base centre** shall mean the geometric centre of the arm's mounting footprint or the central mounting axis defined by the official base plate design.

5.1.3.5. A tolerance of **±10 mm** shall be permitted.

5.1.4. Base

5.1.4.1. The robot shall operate from a fixed base during each competition run.

5.1.4.2. A steady workspace surface shall be provided to which the base of the robot arms will be mounted.

5.1.4.3. Mobile bases, sliding platforms, and any locomotion mechanism are prohibited.

5.1.5. Mounting

5.1.5.1. The robot base assembly shall be mounted to the provided competition workspace using clamps only.

5.1.5.2. Teams are required to bring their own clamps.

Clamps example

5.1.5.3. The robot system shall be mounted on the provided competition workspace using non-destructive clamps only.

5.1.5.4. Fastening methods that damage, penetrate, bond to, or permanently modify the workspace surface or structure shall not be permitted. The mounting arrangement shall ensure that the robot remains stable and secure throughout the competition run.

5.1.5.5. The clamping arrangement shall provide sufficient stability to prevent unintended movement, loosening, or unsafe operation during the competition run.

5.1.5.6. Teams shall provide their own clamps. The clamps used must be compatible with a competition **workspace surface thickness of 15 mm to 40 mm**.

5.1.5.7. The clamping arrangement shall be designed and positioned so that it does not hinder, restrict, obstruct, or interfere with the movement or operation of either robot arm at any time during the competition run.

5.1.5.8. The organizers may reject any clamp or mounting arrangement deemed unsafe, unstable, incompatible with the workspace, or likely to interfere with robot operation.

5.1.6. Dimensions

5.1.6.1. Each robot arm shall comply with the **minimum reach** and **maximum reach** requirements defined for the competition workspace.

5.1.6.2. The "**nearest edge** of the competition table surface" shall mean the table edge closest to the base centre of the respective robot arm.

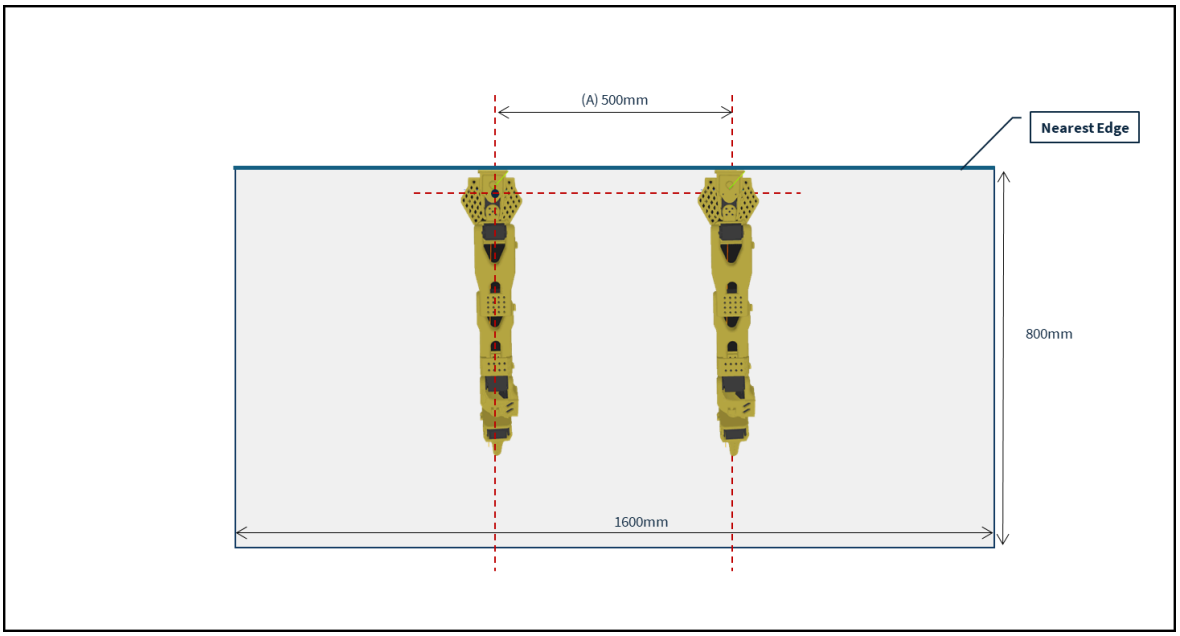


Diagram of workspace from the top, indicating Nearest Edge

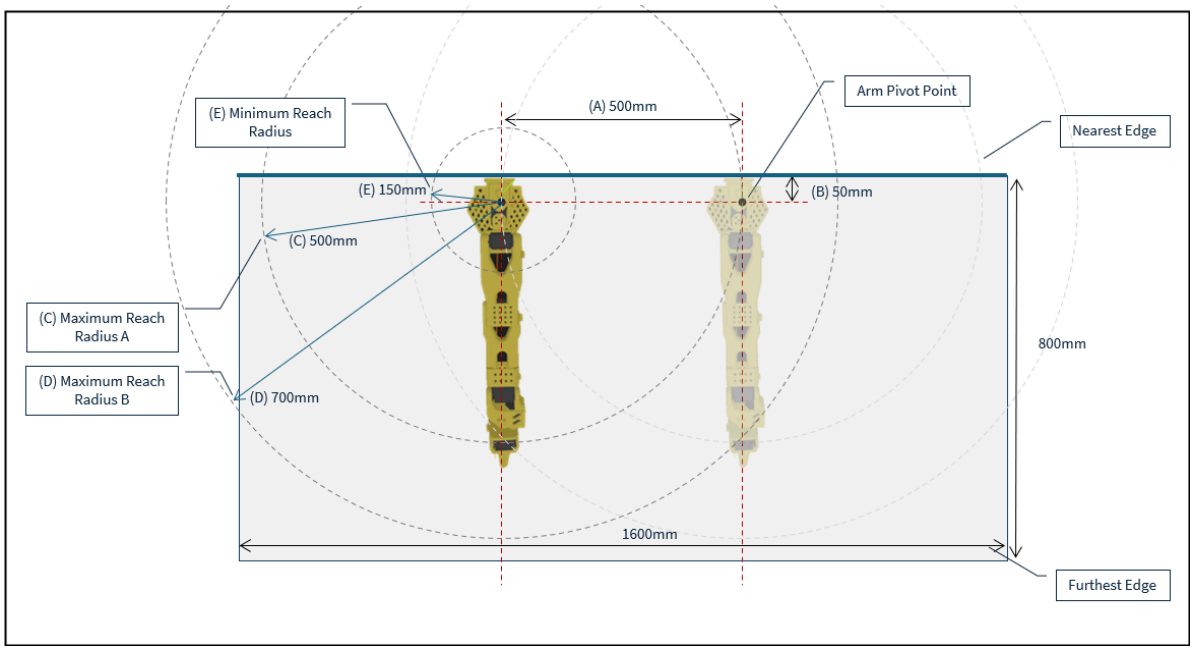
5.1.6.3. The reach radius of a robot arm shall mean the horizontal distance measured from the arm base pivot point of that arm to the projection of the gripper reference point on the workspace plane.

5.1.6.4. The **arm base pivot point** (see diagram below) of a robot arm shall mean the arm pivot point of the shoulder pan.

5.1.6.5. The **gripper reference point** shall mean the functional centre of the gripping interface or the effective grasping point, as determined by the organizers.

5.1.6.6. Reach shall be assessed with the robot arm mounted in its approved competition configuration and extends to the closest and furthest reachable position.

5.1.6.7. The **maximum reach (C)** of each fully extended robot arm using the standard gripper or an approved equivalent of similar dimensions, shall not exceed **700 mm**, measured from the base centre of the arm to the gripper reference point.

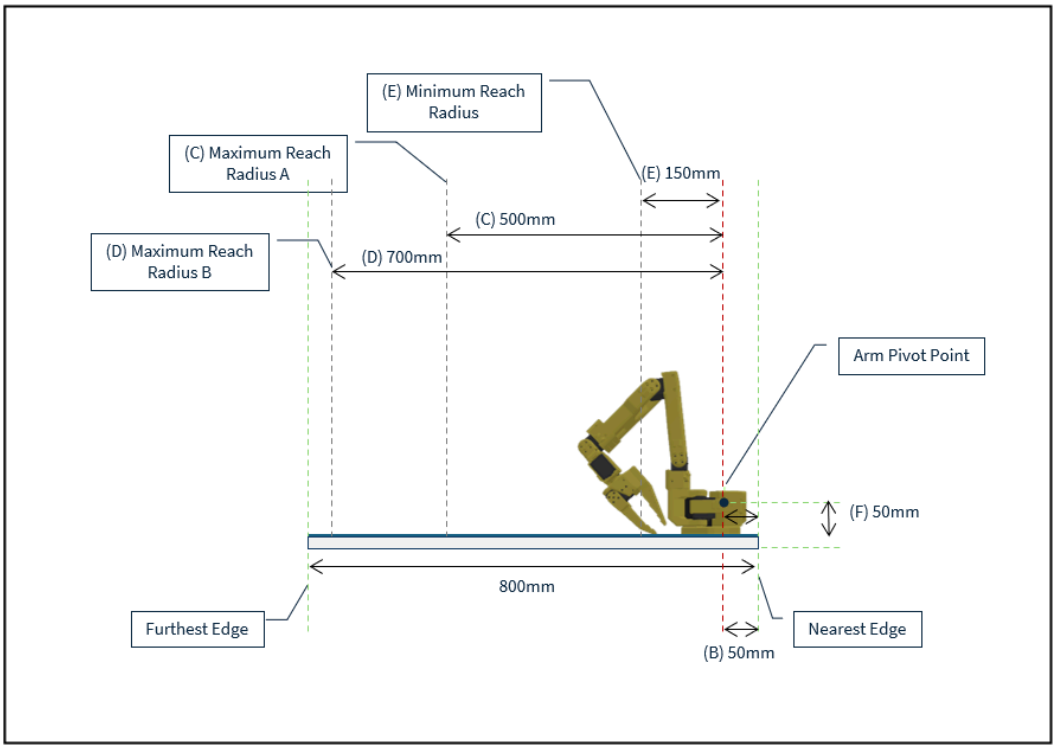


Top View showing pivot point and reach diameter

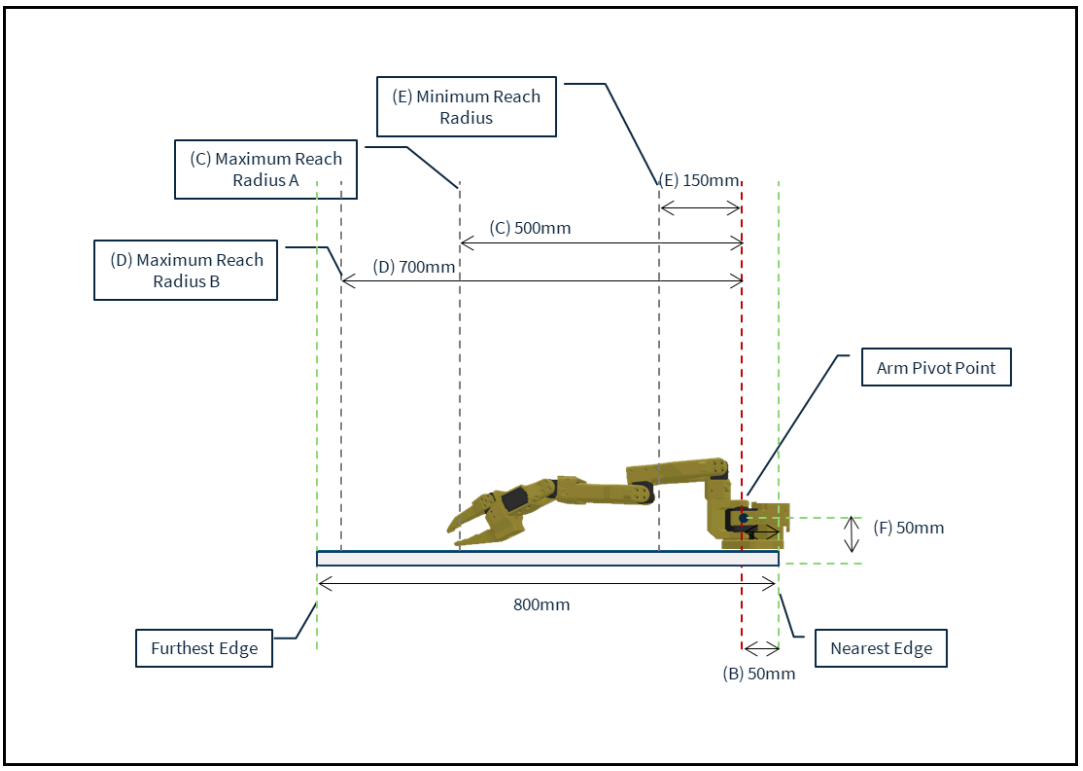
5.1.6.8. Where a team uses a custom gripper design, the fully extended **maximum reach (D)** of the robot arm, including the custom gripper, shall not exceed **700 mm**, measured from the base centre of the arm to the gripper reference point.

5.1.6.9. The **minimum reach (E)** of each robot arm is defined as the capability for the robot arm gripper reference point to reach within **150 mm** of the arm base pivot point.

5.1.6.10. Teams shall not modify the arm structure, mounting arrangement, or end-effector geometry in a manner that causes the robot to exceed the applicable maximum reach limit.



Side View (minimum reach)



Side View (arm fully extended)

5.1.7. Mounting Poles

5.1.7.1. Two mounting poles will be provided as part of the workspace.

Workspace setup showing mounting poles

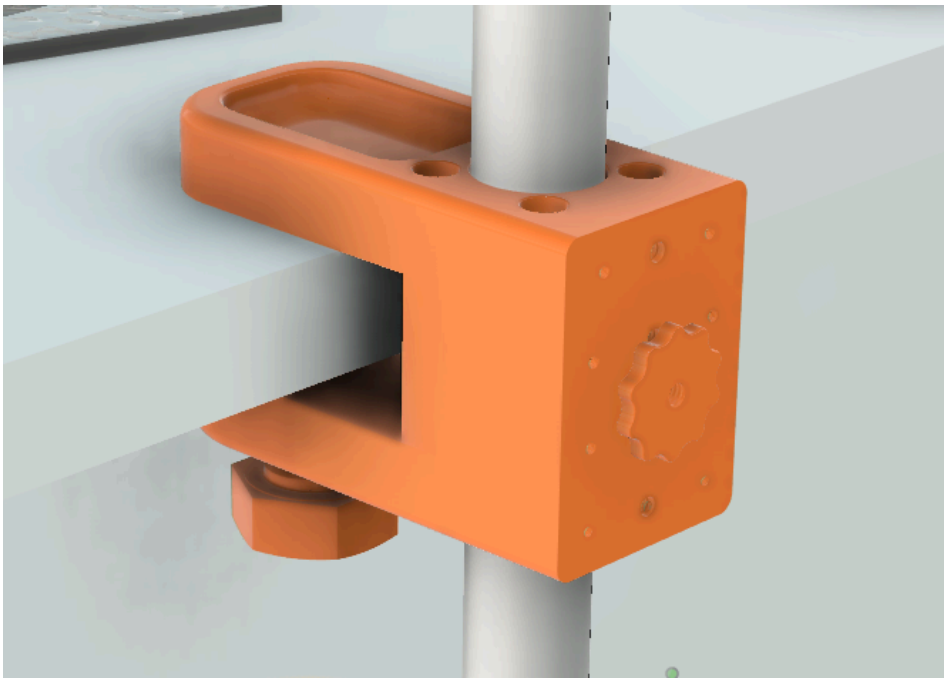
5.1.7.2. These poles are made of aluminium and have a diameter of **25mm**.

5.1.7.3. The poles will be 1m in length.

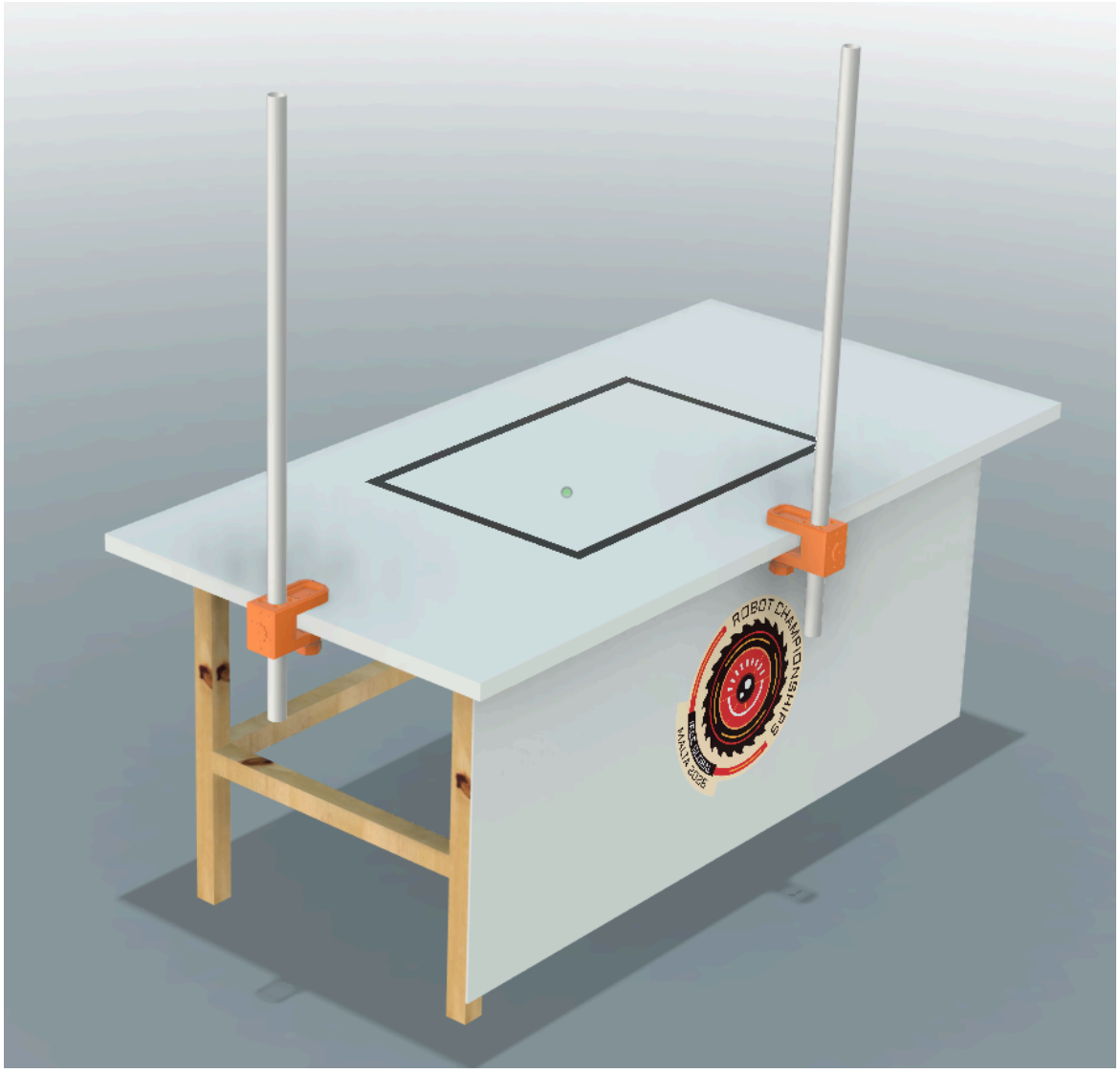
5.1.7.4. The poles are attached to the workspace using a clamp.

5.1.7.5. Teams are to bring their own clamping mechanism to attach their cameras **to the poles**. No clamp or mount will be provided for cameras by the organising committee during the event.

5.1.7.6. The clamps **that mount the poles to the table** are 3D printable and STL files and assembly specification shall be provided on the resources site.



5.1.7.7. The organising committee will provide the setup as shown below for the competition.



5.1.7.8. The team is responsible for the positioning of the poles.

5.1.7.9. The team can choose the placement of the poles as long as these are within the perimeter of the workspace.

5.1.7.10. No other camera mounting structure will be allowed unless approved by judges. Approval must be requested at least 3 weeks ahead of the competition.

5.2. Motive Power

5.2.1. Fixed-Base Operation

5.2.2. Each robotic arm used in the competition shall operate from a fixed base position within the team's assigned workspace.

5.2.3. The robot arm base shall remain stationary during task execution unless a specific game explicitly permits repositioning.

5.2.4. Robot arms shall not use wheels, tracks, walking mechanisms, sliding bases, rail systems, or any other form of locomotion to move the base of the robot during a match, unless expressly permitted in the rules of a specific challenge.

5.2.5. Motion is limited to the articulated joints, end effector, and any approved mechanisms that form part of the declared robotic arm assembly.

5.2.6. Prohibited Propulsion or Launching

5.2.6.1. Robots shall not use any mechanism that launches, throws, ejects, catapults, or otherwise propels objects in an uncontrolled or ballistic manner except for red blocks thrown towards opposing tower as per section 5.8.4.

5.2.6.2. Any task interaction must be performed through controlled physical manipulation of objects with the gripper.

5.2.7. Sensors

5.2.7.1. The team shall decide what sensors and/or cameras they will use as part of their setup.

5.2.7.2. These can be:

- Mounted to the robot arms
- Positioned within the workspace provided (as long as they do not interfere with the movement of the robot arm)
- Mounted to the pole arrangement described in the configuration.

5.2.7.3. It is recommended to use wired cameras and sensors as interference may affect bandwidth and quality of signal.

5.3. Power

5.3.1. Robotic systems shall be powered only by electrical energy.

5.3.2. Permitted power sources may include:

- external low-voltage DC power supplies
- approved AC-to-DC power adapters connected through the designated competition power interface

5.3.3. AC-to-DC adapters must support 240V supply (100V supply will not be provided).

5.3.4. The organisers will make a 6-socket power strip (one for training table and one for competition workspace) with UK sockets available at each station. Teams are to ensure that they have the corresponding power plugs/adapters as these will not be provided.

Power strip showing 4x UK type sockets

5.3.5. Each team must declare all power sources, voltage ranges, current ratings, battery chemistries, and power distribution arrangements during technical inspection.

5.3.6. No exposed or user-accessible part of the robotic system shall operate above **48V**

5.3.7. If used all batteries must be securely mounted and protected against short circuit, mechanical damage, puncture, and accidental disconnection.

5.3.8. Damaged, swollen, leaking, or visibly compromised batteries shall not be permitted.

5.3.9. Teams using lithium-based batteries must use appropriate charging, storage, and protection circuitry in accordance with the manufacturer's guidance.

5.3.10. Teams are responsible for ensuring that their power system does not create unsafe overheating, arcing, electrical noise, or interference that disrupts competition operations or other teams.

5.4. Autonomy & Connectivity

The competition is intended to evaluate robotic autonomy, not human teleoperation. Teams may prepare, configure, and monitor their systems, but during a scored run they must not directly control the robot's movements or decision-making. If a human tells the robot exactly what motion to perform, when to perform it, or how to correct an action in real time, that constitutes prohibited intervention.

5.4.1. Software & AI Models

5.4.1.1. Teams are to decide which software stack and AI models to adopt for the training of the robot arms and the operation during the competition.

5.4.1.2. Teams are to pre-train their system for the different games.

5.4.1.3. It is not necessary or required to have one single implementation for all games.

5.4.1.4. Use of Open Source models is encouraged.

5.4.1.5. Teams are to submit a report on the software stack, AI models, methods used and insights to the organising committee ahead of the competition.

5.4.1.6. Teams are to submit model weights, datasets or source code before the start of the championship during registration.

5.4.1.7. IEEE reserves the right to use the submitted report and models including code for research studies,.

5.4.2. Connectivity

5.4.2.1. The robot arms motor drivers and/or microcontrollers are to be connected to a single computer throughout the games for processing of sensors and control of the motion.

5.4.2.2. The robot arm operations cannot rely on remote servers, cloud servers or any other compute capability beyond that of the computer physically connected to the robot arms.

5.4.2.3. Teams are required to get the necessary USB hubs and cables to connect the robot arms and cameras.

- It is also recommended to get suitable USB extension cables assuming a distance of a maximum of 2 meters between your computer and the workspace.
- Ensure to test the target setup that you will use during the competition including connectivity, reliability and bandwidth requirements.

5.4.3. Autonomy

5.4.3.1. **Autonomous Perception and Decision-Making**: During every scored run, the robotic system shall rely on autonomous perception and decision-making derived from live sensory input.

5.4.3.2. The robotic system shall perceive the competition environment using onboard or directly connected sensors and shall determine object identity, object pose, target location, and task state from those live observations.

5.4.3.3. Autonomous operation means that the robotic system must perceive the environment, interpret task conditions, make decisions, and execute actions through its own sensing, computation, and control systems without direct low-level human control.

5.4.3.4. The robotic system shall not rely solely on pre-programmed coordinates, fixed trajectories, or static assumptions about exact object placement.

5.4.3.5. Execution based solely on memorised object positions, pre-recorded spatial layouts, or deterministic scripts that do not use live perception shall be prohibited.

5.4.3.6. Human-assisted correction, relabeling, prompting, or intervention intended to influence object detection, classification, target selection, or motion generation during a scored run shall be prohibited.

5.4.3.7. To verify compliance with this requirement, the organizers may introduce controlled variability between runs, including:

- variation in object positions within defined start zones
- variation in object orientation
- variation in destination bin placement where permitted by the round specification
- minor variation in ambient lighting conditions

5.4.3.8. Each competing system shall be expected to remain functional and effective under such controlled variability.

5.4.3.9. During scored runs, robots must operate autonomously and may not be directly teleoperated by a human.
- Internal wired or wireless communication within the declared robotic system is permitted.
- External network access shall be limited to approved competition infrastructure, and public internet access during scored runs is prohibited unless explicitly allowed by the organizers.

5.4.3.10. During a scored run, team members may observe the system and monitor its status through:.
- Passive supervision
- Viewing system telemetry
- Viewing camera feeds
- Viewing sensors status
- Monitoring logs, state displays, or dashboards
- Issuing an emergency stop where safety requires it

5.4.3.11. Passive supervision shall not influence robot behavior except through mechanisms expressly permitted by the rules of the relevant challenge.

5.4.4. Human Input

5.4.4.1. Human input during a scored run is prohibited unless expressly allowed by the rules of a specific challenge.

5.4.4.2. Where permitted, human input must be limited to high-level intent, strategy, or task preference and must not constitute direct motion control, trajectory specification, or step-by-step manipulation.

5.4.4.3. No team member may physically touch, reposition, stabilize, guide, or otherwise manipulate the robot, game elements, or task environment during a scored run.

5.4.4.4. No team member may control the robot in real time through:

- joystick input
- keyboard or mouse commands
- touchscreen commands
- gamepad control
- haptic device input
- live command streaming
- direct gripper open/close control
- joint-by-joint or Cartesian motion commands

5.4.4.5. No team member may provide real-time corrective or incremental instructions intended to directly guide execution.

5.4.5. LOCAL COMPUTE, NETWORK RESTRICTIONS AND AI MODELS

5.4.5.1. The team is responsible for providing the computer on which the software controlling the robot arms shall run. The organising committee shall not provide any computers during the competition.

5.4.5.2. There are no specific requirements for the computer to be used.

5.4.5.3. Teams may not alter system logic, model parameters, control policies, calibration values, or task scripts during a scored run, except where a challenge explicitly permits limited strategic input.

5.4.5.4. During a scored run, all perception, inference, planning, and control required for task execution shall be performed on computation physically present within the team's declared competition setup.

5.4.5.5. The robot system shall not depend on cloud services, remote servers, remote APIs, or any external compute resource not physically present at the competition station.

5.4.5.6. Public internet access during a scored run shall be prohibited unless explicitly authorised by the organizers for a specific competition function.

5.4.5.7. Internal communication within the declared robot system, including communication between sensors, controllers, compute devices, and motor controllers, shall be permitted.

5.4.5.8. Teams shall declare their compute architecture during technical inspection, including:

- main processing device or devices
- control interfaces
- sensor interfaces
- any internal network connections used during execution

5.4.5.9. Any hidden external assistance, remote operator support, or undeclared offboard compute dependency shall constitute a serious rules violation and may result in disqualification.

5.4.5.10. The system shall not rely exclusively on:

- manually defined rules
- deterministic pipelines
- fixed coordinate-based execution

5.4.5.11. A system that performs the task without using learned representations derived from data shall not be considered compliant with the objectives of the competition.

5.4.6. Model Training

5.4.6.1. The robotic system shall use one or more AI-based models to perform perception, decision-making, or control.

5.4.6.2. AI-based models may include, but are not limited to:

- imitation learning models

- behavior cloning models
- reinforcement learning models
- vision-language-action (VLA) models
- diffusion or policy-based models

5.4.6.3. For training the models the teams can use any of the following methods:

- **Leader - Follower**: Leader arms are used to manually control the robot arms whilst camera and sensor recordings are captured. These recordings are then used to train the AI model.
- **Simulation** - A virtual simulation of the robot arms are used to train against various simulated configurations and scenarios, The simulation data is used to train the AI model.
- **Teleoperation** - Using a VR headset the team controls a virtual instance of the arm which is translated into actuals motion. The data is recorded for training the AI model.

5.5. CALIBRATION

5.5.1. Before the start of a scored run, teams may:

5.5.1.1. power on and initialize the system

5.5.1.2. calibrate sensors and actuators

5.5.1.3. load software, models, task parameters, and configuration files

5.5.1.4. position the robot within the permitted starting configuration

5.5.1.5. start the run using the approved start procedure

5.5.2. Teams will be given dedicated time for calibration of their systems.

5.5.3. Calibration must be completed prior to the start time of the game.

5.5.4. Teams will be provided with an additional workspace for setting up leader arms and laptop/computer. This will be separate from the main workspace for the robot arms.

5.6. ADD-ONS

5.6.1. Cameras

- There are no restrictions or limitations on the use of cameras.
- Camera attachment on the robot arms and the workspace must not change the configuration of the setup as described in the previous sections.

5.6.2. Sensors

- The team may choose to enhance the robot arms with additional sensors including but not limited to touch, pressure and distance measurement.

5.6.3. Custom Gripper

- Teams may use alternative gripper design as long as they comply with the regulations including the minimum and maximum reach radius.

5.7. SAFETY

5.7.1. The robotic system must remain mechanically stable throughout operation. Any configuration that creates a risk of tipping, collapsing, uncontrolled swinging, or detachment of parts may be disallowed by the judges or technical inspection team.

5.8. Robot Arm AI Challenge Games

5.8.1. Qualification Phase

Teams compete in two qualification games to earn points and secure a place on the overall leaderboard. The top two teams will advance to the final, where they face off in the **Tower Construction Challenge** to determine the overall champion.

QUALIFICATION	
GAME 1: Pick-and-Place	**Round 1: Color Sort**
	Round 2: Shape Sort
	Round 3: Dynamic Sort
GAME 2: Two-Arm Coordination	**Round 1 : Pouring**
	Round 2 : Folding
	Round 3 : Wrap a Pack

GAME 1: Pick-and-place

Robots must identify objects using raw sensory data and place them in the correct destination bins according to the sorting rule

defined for each round.The objective is to correctly position all objects with the highest possible accuracy in the shortest possible time.

In Game 1, the robot system shall autonomously detect, classify, pick, move, and place standardized competition objects into the correct destination bins according to the sorting rule defined for each round.

5.8.1.1. This game is intended to evaluate foundational Physical AI capabilities, including:

- perception from raw sensory input
- object colour recognition
- object shape recognition
- destination bin identification
- autonomous grasping and placement
- task efficiency
- placement accuracy
- effective coordination between two robot arms where applicable

This game shall not require dexterous (handling objects with both arms) manipulation, in-hand regrasping, force fitting, assembly, fastening, or the coordinated two-arm handling of a single object.

5.8.1.2. Game 1 shall consist of **three rounds of increasing difficulty**. Each round shall require robots to sort objects into destination bins under round-specific rules.

5.8.1.3. The competition system may use one or two robot arms. The game shall be designed so that:

- successful completion is possible without requiring simultaneous two-arm manipulation of a single object
- the use of two robot arms may provide a performance advantage through parallelization, improved reach, or task allocation

Object Standard

5.8.1.4. All competition objects shall be based on STL files issued by the organizers.

5.8.1.5. The STL files shall be made available to participating teams in advance for training and testing purposes.

5.8.1.6. Each official object shape will have a published nominal size and tolerance

- Example: nominal characteristic size: 40 mm ± 2 mm

5.8.1.7. It is recommended to print the objects for training the models using PLA or PLA+ as it would have similar constituency and weight.

5.8.1.8. It is important to note that the color of the filament used to print the bins and objects to match or be very close to the published colors. This may affect the training of the model. During the competition participants must use the objects that will be provided by the organisers.

5.8.1.9. The organizers shall define the nominal mass range or print specification for each official object to ensure comparable handling characteristics across the object set.

5.8.1.10. Official competition objects used during matches shall conform to the organizer-defined geometry, nominal dimensions, colour specification and material or finish requirements, where applicable.

Colors

5.8.1.11. The official colours for Game 1 objects shall be: **Red**, **Blue**, **Green**, and **Yellow**. These colours shall be used for the official competition objects and for the destination bins.

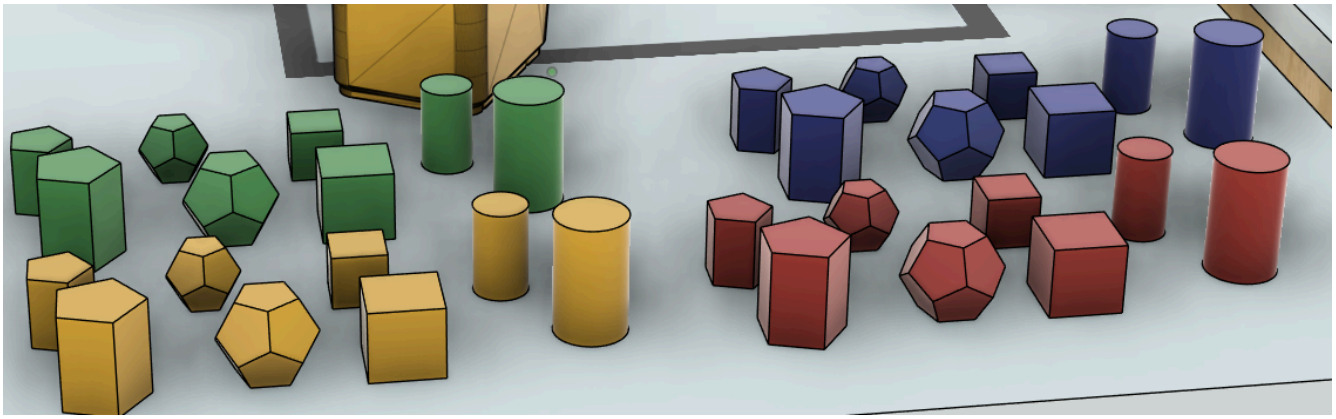
5.8.1.12. The materials and colors used for the printing of the objects that shall be provided by the organising committee shall be published on the competition website. (https://www.ieeemalta.org/ieee-robot-championship-2026/)

5.8.1.13. Official competition objects shall be produced by the organizers using organizer-defined geometry, dimensions, colour references, and surface finish. Objects shall use a matte or low-gloss surface finish to ensure consistent visual perception conditions across teams.

Object Geometry & Quantity

5.8.1.14. The official object set shall consist of four standardized shapes.

- Cube
- Cylinder
- Dodecahedron
- Hexagonal Prism



5.8.1.15. Each shape shall be printable from the STL files issued by the organizers and shall be designed to:

- rest stably on a flat surface
- be visually distinguishable from the other official shapes
- be suitable for grasping using common robot grippers
- avoid requiring dexterous handling

5.8.1.16. Together with the published STL files the organiser will communicate the material, infill requirements, weight and dimensions of each object.

5.8.1.17. Training STL files are provided to support team preparation. In the event of any difference between a team-produced training print and the official organizer-supplied competition object or bin, the official organizer-supplied item shall govern for match play.

5.8.1.18. Training STL files for the official object set shall be published by the organizers for team preparation, model training and testing. Official competition-day objects shall be supplied by the organizers. In the event of any discrepancy, the organizer-supplied official objects shall prevail.

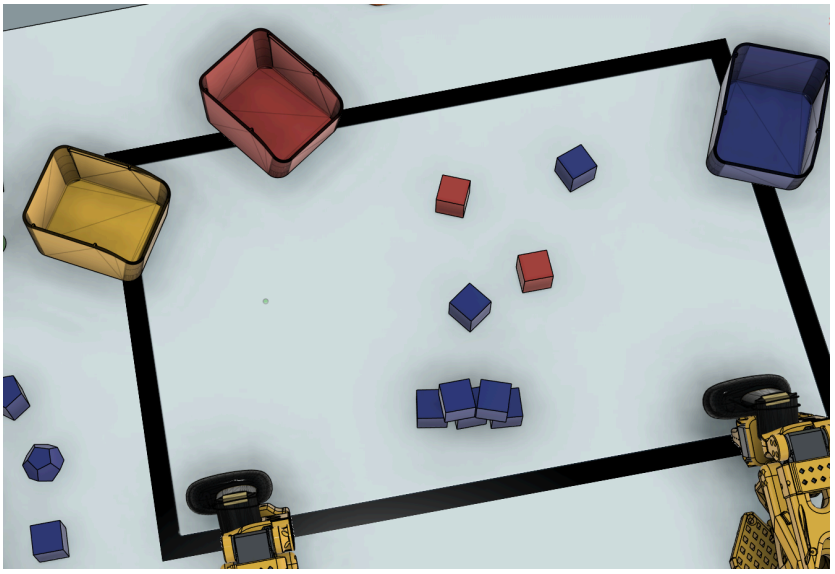
5.8.1.19. Official competition objects shall use organizer-defined colour references and a matte or low-gloss surface finish.

5.8.1.20. Each object shall be manufactured to organizer-defined nominal dimensions and tolerances as published in the technical specification.

5.8.1.21. The quantity of objects presented in each round shall be defined in the official round specification.

Source Area

5.8.1.22. At the start of each round, all objects shall be placed within the designated **source area (marked with black tape)** in stable resting poses randomly.



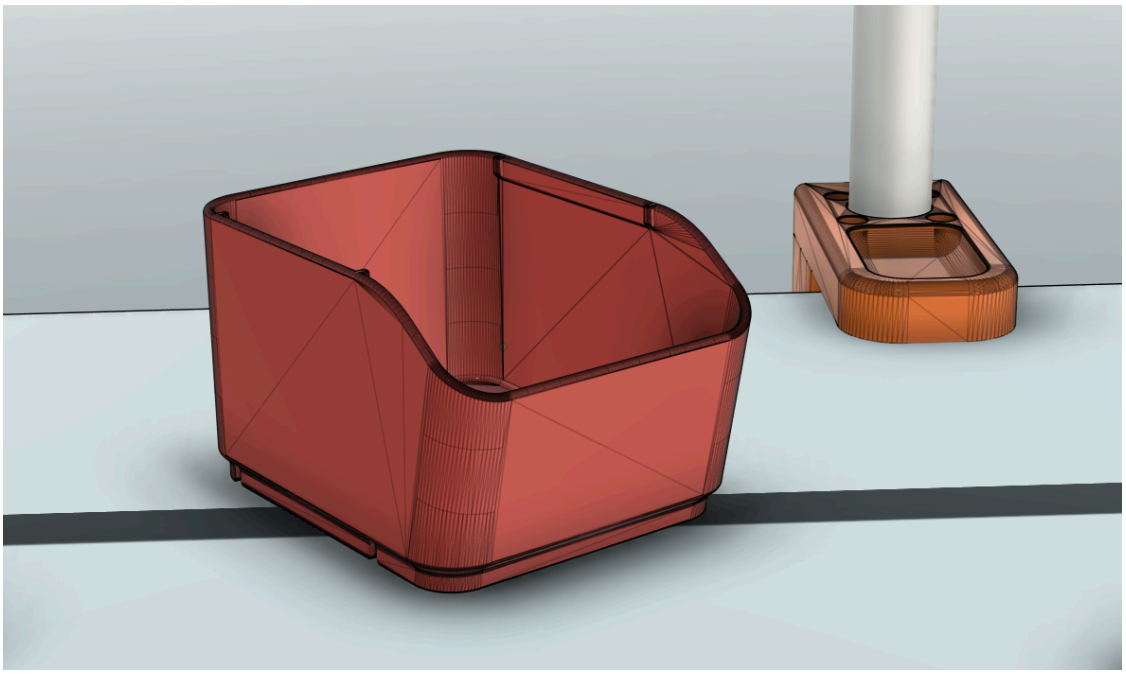
5.8.1.23. The source area shall be visibly marked on the field surface. At the start of the round, all competition objects shall be fully contained within the source area boundary.

5.8.1.24. Objects shall not be stacked unless explicitly stated in the round specification.

5.8.1.25. In Round 1, objects shall be placed with sufficient spacing to avoid significant occlusion. In Rounds 2 and 3, denser placement and limited object-to-object contact may be permitted, provided all objects remain physically accessible without requiring dexterous manipulation.

Destination Bins

5.8.1.26. Objects will need to be placed in bins.



5.8.1.27. Each destination bin shall include:
- a visible exterior colour corresponding to its official bin colour

5.8.1.28. Each bin shall:
- be open at the top
- have rigid side walls
- be sized to allow uncomplicated top placement of official competition objects
- avoid requiring fine insertion or force fitting

5.8.1.29. There will be 4 destination bins:
- BIN-RED
- BIN-BLUE
- BIN-GREEN
- BIN-YELLOW

5.8.1.30. The four destination bins shall be placed in organizer-defined positions within the competition workspace.

5.8.1.31. Bin positions may remain fixed or may change between rounds, as defined in the official round specification.

5.8.1.32. Teams shall not deliberately move, rotate, tilt, or otherwise manipulate the bins during match play. A bin displaced by robot contact may result in penalties or match intervention, as defined by the competition-wide rules.

5.8.1.33. Training STL files for destination bins shall be published by the organizers for team preparation. Official competition-day bins used for scoring shall be supplied by the organizers. In the event of any discrepancy, the organizer-supplied official bins shall prevail.

Round 1 — Colour Sort

5.8.1.34. In Round 1, each object shall be placed into the bin matching the colour of that object.

- Red object → Red bin
- Blue object → Blue bin
- Green object → Green bin
- Yellow object → Yellow bin

5.8.1.35. Object shape shall not affect scoring in this round.

5.8.1.36. Round 1 is intended to evaluate:

- basic object detection
- colour recognition
- simple target selection
- basic pick-and-place execution

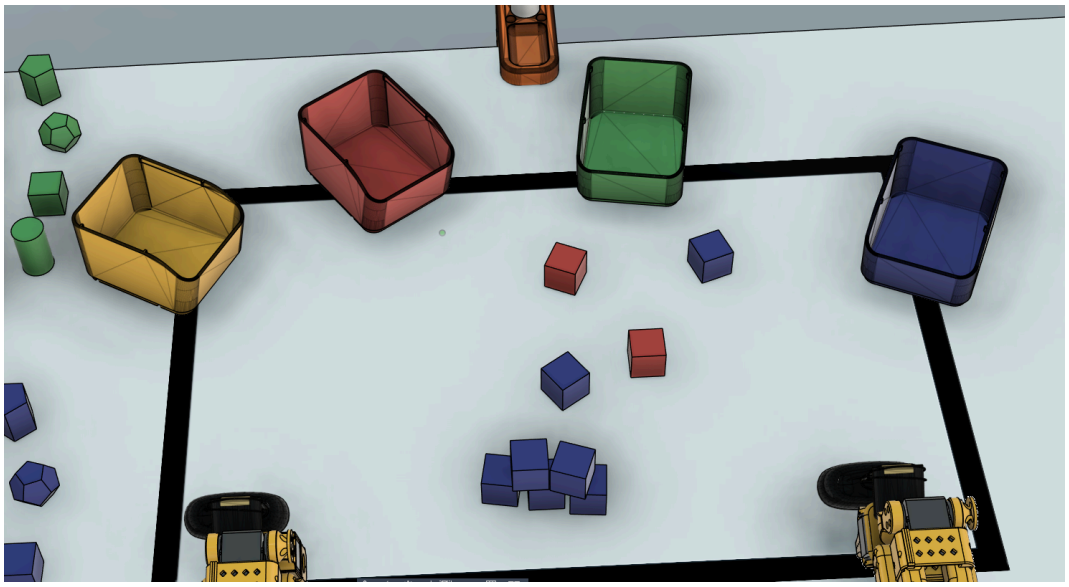
5.8.1.37. Shape quantity and sizes

- 1 x small red cube
- 1 x small red cylinder
- 1 x small red dodecahedron
- 1 x small red hexagonal prism
- 1 x small greencube
- 1 x small green cylinder
- 1 x small green dodecahedron
- 1 x small green hexagonal prism

- 1 x small yellow cube
- 1 x small yellow cylinder
- 1 x small yellow dodecahedron
- 1 x small yellow hexagonal prism
- 1 x small blue cube
- 1 x small blue cylinder
- 1 x small blue dodecahedron
- 1 x small blue hexagonal prism
- 1 x large red cube
- 1 x large red cylinder
- 1 x large red dodecahedron
- 1 x large red hexagonal prism
- 1 x large greencube
- 1 x large green cylinder
- 1 x large green dodecahedron
- 1 x large green hexagonal prism
- 1 x large yellow cube
- 1 x large yellow cylinder
- 1 x large yellow dodecahedron
- 1 x large yellow hexagonal prism
- 1 x large blue cube
- 1 x large blue cylinder
- 1 x large blue dodecahedron
- 1 x large blue hexagonal prism

5.8.1.38. **Start Condition**: At the start of each round:

- Objects are placed randomly in the marked area in front of the arms
- Bins are arranged in the workspace (within reach of the maximum reach radius)



5.8.1.39. **End Condition**: At the end of the round:
- the round time limit expires
- a judge stops the run in accordance with the competition rules, or
- All objects in bins

Round 2 — Shape Sort

5.8.1.40. In Round 2, each object shall be placed into a destination bin according to its shape, regardless of the object's colour.

5.8.1.41. The official shape-to-bin mapping shall be defined in the game rules.
- Cube → Red bin
- Cylinder → Blue bin
- Dodecahedron prism → Green bin
- Hexagonal prism → Yellow bin

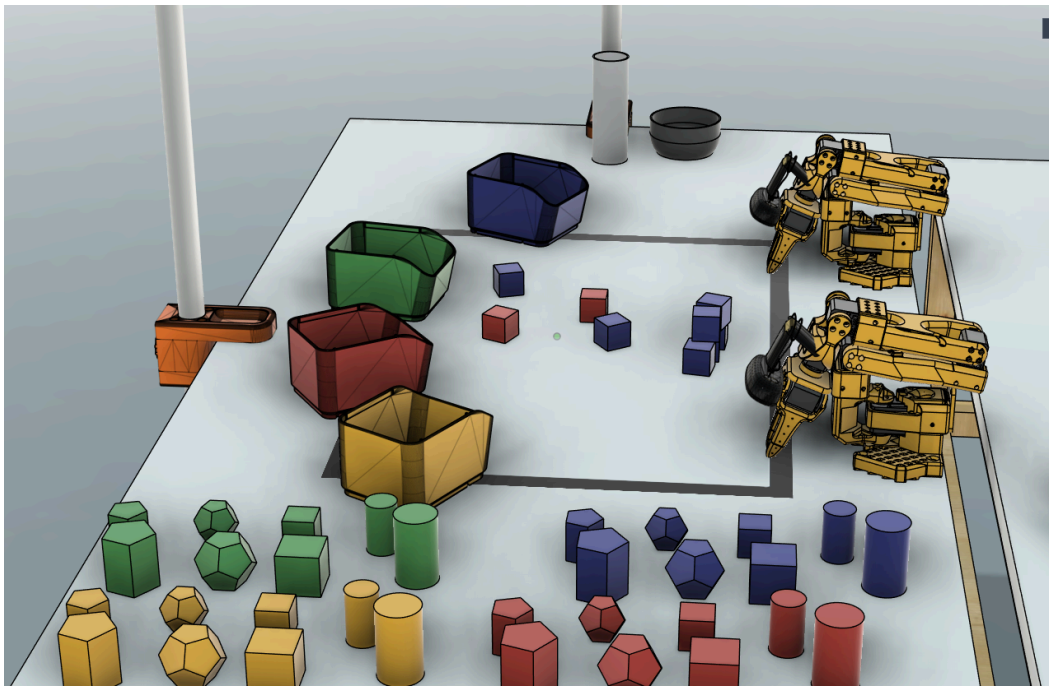
5.8.1.42. Round 2 is intended to evaluate:
- shape recognition
- object classification independent of object colour
- correct target assignment
- efficient autonomous sorting

5.8.1.43. Shape quantity and sizes

- 1 x small red cube
- 1 x small red cylinder
- 1 x small red dodecahedron
- 1 x small red hexagonal prism
- 1 x small greencube
- 1 x small green cylinder
- 1 x small green dodecahedron
- 1 x small green hexagonal prism
- 1 x small yellow cube
- 1 x small yellow cylinder
- 1 x small yellow dodecahedron
- 1 x small yellow hexagonal prism
- 1 x small blue cube
- 1 x small blue cylinder
- 1 x small blue dodecahedron
- 1 x small blue hexagonal prism
- 1 x large red cube
- 1 x large red cylinder
- 1 x large red dodecahedron
- 1 x large red hexagonal prism
- 1 x large greencube
- 1 x large green cylinder
- 1 x large green dodecahedron
- 1 x large green hexagonal prism
- 1 x large yellow cube
- 1 x large yellow cylinder
- 1 x large yellow dodecahedron
- 1 x large yellow hexagonal prism
- 1 x large blue cube
- 1 x large blue cylinder
- 1 x large blue dodecahedron
- 1 x large blue hexagonal prism

5.8.1.44. **Start Condition**: At the start of each round:

- Objects are placed randomly in the marked area in front of the arms
- Bins are arranged in the workspace (within reach of the maximum reach radius)



5.8.1.45. **End Condition**: At the end of the round:

- the round time limit expires
- a judge stops the run in accordance with the competition rules, or
- All objects in bins

Round 3 — Dynamic Sort

5.8.1.46. In Round 3, each object shall again be sorted according to the official shape-to-bin mapping, regardless of object colour.

5.8.1.47. Different from the previous challenge, the physical positions of the bins will be changed in real-time by a judge whilst the robot is moving hence the robot arm must constantly detect changes in position of the bins.

5.8.1.48. Different from the previous challenge, the physical positions of the objects in the pick area may be moved randomly by a judge hence the robot arm must constantly detect changes in position of the object to pick.

5.8.1.49. Teams shall identify the live object and bin location from the field setup using autonomous perception.

5.8.1.50. Round 3 is intended to evaluate:

- robust shape recognition
- live target identification
- reduced reliance on hardcoded spatial assumptions
- efficient sorting under increased autonomy requirements

Scoring

5.8.1.51. Each object shall be scored according to its final resting state at the end of the round or at the time of official scoring.

5.8.1.52. An object resting fully inside the wrong bin shall score zero for correctness.

5.8.1.53. Only the final resting position of an object at the time of scoring shall determine its validity, unless otherwise stated in the round procedure.

5.8.1.54. Objects may rest on other objects within a bin, provided each object is fully contained within the bin walls and stationary at the time of scoring. Objects on top of each other raising above the bin are valid as long as they are in the bin.

5.8.1.55. Objects and bins are placed within the workspace by the judges and teams cannot intervene in manually changing the position of objects or bins prior to or during a game.

5.8.1.56. A team may declare completion before the round time expires. Completion time shall then be recorded for time-based ranking or tie-break purposes.

5.8.1.57. A team who completes the challenge (i.e. placing all the objects in the correct bin) before the elapsed time will be allotted 10 bonus points.

5.8.1.58. For Game 1 rounds the scoring will be taken on the average of the 3 rounds with each shape placed in the right container being given the following points:

Color	Shape	Size	Points
Red	Cube	Small	1
Red	Cylinder	Small	2
Red	Dodecahedron	Small	3
Red	Hexagonal Prism	Small	5
Blue	Cube	Small	1
Blue	Cylinder	Small	2
Blue	Dodecahedron	Small	3
Blue	Hexagonal Prism	Small	5
Green	Cube	Small	1
Green	Cylinder	Small	2
Green	Dodecahedron	Small	3
Green	Hexagonal Prism	Small	5

Color	Shape	Size	Points
Yellow	Cube	Small	1
Yellow	Cylinder	Small	2
Yellow	Dodecahedron	Small	3
Yellow	Hexagonal Prism	Small	5
Red	Cube	Large	2
Red	Cylinder	Large	3
Red	Dodecahedron	Large	4
Red	Hexagonal Prism	Large	5
Blue	Cube	Large	2
Blue	Cylinder	Large	3
Blue	Dodecahedron	Large	4
Blue	Hexagonal Prism	Large	5
Green	Cube	Large	2
Green	Cylinder	Large	3
Green	Dodecahedron	Large	4
Green	Hexagonal Prism	Large	5
Yellow	Cube	Large	2
Yellow	Cylinder	Large	3
Yellow	Dodecahedron	Large	4
Yellow	Hexagonal Prism	Large	5
Total			**100**

5.8.1.59. Placement of the object in a wrong bin will result in negative points.

e.g. In round 1, **Yellow Hexagonal Large Prism** in **Green Bin** is incorrect, 5 points will be deducted.

5.8.1.60. *Round Score = max(0, Correct Object Points − Incorrect Object Penalties + Completion Bonus)*

5.8.1.61. *If the total score is less than 0 the team will get 0 points. I.e. there is no negative scoring*

5.8.1.62. If the total score is more than 100 the team will get 100 points i.e. final score cannot exceed 100

5.8.1.63. Game 1 Score = (R1 + R2 + R3) / 3

5.8.1.64. Scoring criteria may be revised by the organisers in a later stage - a communication to registered teams will be sent.

GAME 2: Two-Arm Coordination

This game consists of a sequence of tasks that must be completed using two robotic arms to achieve a defined objective. Successful completion requires coordinated bimanual manipulation, precise timing, and the execution of multiple sequential actions.

5.8.1.65. The robot system shall autonomously use two robotic arms to complete coordinated multi-step manipulation tasks. Successful completion shall require both arms to contribute meaningfully through stabilization, transfer, alignment, or simultaneous action.

5.8.1.66. The three rounds are:

- Round 1: Pouring
- Round 2: Folding
- Round 3: Wrap and Pack

5.8.1.67. Unless otherwise specified, all objects, dimensions, tolerances, and layouts shall be standardized by the organizing committee and communicated to all teams in advance.

5.8.1.68. Game 2 is intended to evaluate advanced Physical AI capabilities beyond basic pick-and-place. In particular, this game is intended to assess:

- coordinated use of two robotic arms
- synchronized motion and timing
- object stabilization by one arm while the other arm performs an action
- controlled transfer of objects between arms where required
- accurate alignment and positioning
- execution of dependent sequential actions
- task efficiency and completion reliability

5.8.1.69. For a run to be valid:

- both arms shall be used meaningfully during execution of the task
- the required sequence of actions shall be completed in the intended order
- the robot shall operate autonomously in accordance with the general competition regulations
- no prohibited human intervention shall occur during the run

5.8.1.70. **Start Condition**: At the start of each round:

- all competition objects shall be placed in their predefined starting positions
- both robot arms shall begin from the prescribed start state
- the robot shall not be in contact with any competition object unless explicitly permitted by the round definition
- timing shall begin on the official start signal

5.8.1.71. **End Condition**: A run shall end when:

- the robot signals task completion
- the round time limit expires
- a judge stops the run in accordance with the competition rules

5.8.1.72. **Completion Condition**: A task element shall count as successfully completed only if:

- the required action has been completed in the correct sequence
- the final state satisfies the round requirement

- the object or structure remains stable in its final state for the validation period defined by the organizers
- no prohibited shortcut or invalid intervention was used

5.8.1.73. **Autonomous Recovery**: The robot may attempt autonomous recovery from minor execution errors, provided that:
- the recovery is performed fully autonomously
- the robot remains within the competition workspace and rules
- no prohibited human assistance is provided
- the recovery does not involve resetting the round unless explicitly permitted

5.8.1.74. **Meaningful Use of Both Arms**: For Game 2, both robotic arms shall contribute meaningfully to task completion.

5.8.1.75. The following shall not on their own constitute meaningful two-arm coordination:
- one arm remaining idle while the other performs the task
- one arm making trivial or incidental contact without contributing to task success
- one arm merely hovering in the workspace
- two separate independent one-arm actions where the round requires cooperation on the same task objective

5.8.1.76. The judges shall determine whether both arms were used meaningfully in accordance with the round intent.

Round 1 – Pouring

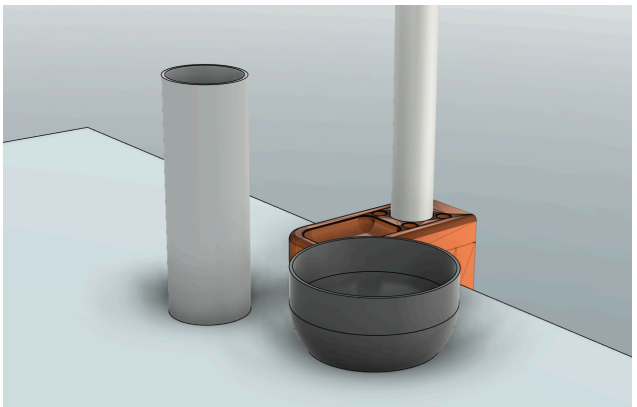
5.8.1.77. Robots must coordinate two arms to transfer rice from a container into a bowl accurately and with minimal spillage.

Objective

5.8.1.78. The robot shall use two robotic arms to transfer rice from a source container into a target bowl accurately and with minimal spillage.

Competition Objects

5.8.1.79. The following objects shall be used:
- 1 source container (show below in grey)
- 1 target bowl (shown below in dark grey)
- rice (uncooked) as the transfer material



Standard Object Specification

5.8.1.80. The Organizing Committee shall provide or approve the following standard objects:

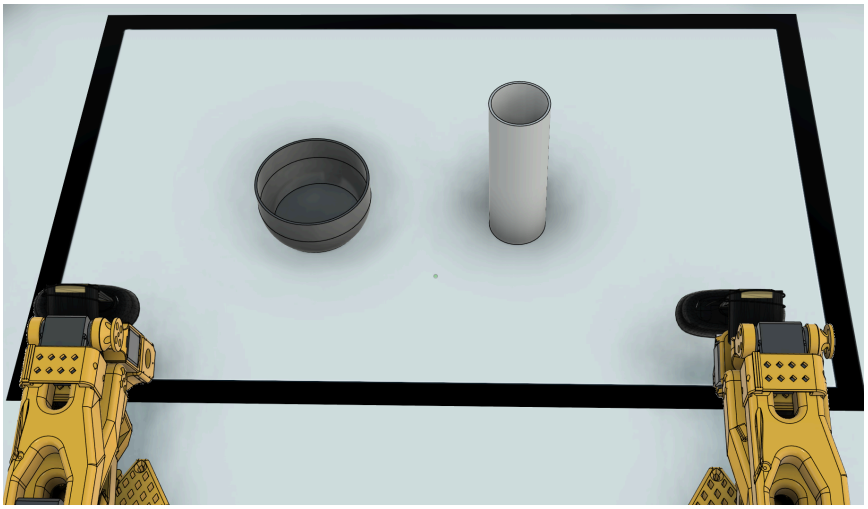
5.8.1.81. **Source container**: cylindrical or cup-shaped rigid container
- Top opening diameter: 60 mm
- Height: 150 mm
- Empty weight: approx. 39g
- Filled with 125g of uncooked white rice

5.8.1.82. **Target bowl**: rigid bowl with circular opening
- Top opening diameter: 140 mm
- Height: 80 mm
- Empty weight: approx. 33g will be measured prior to the start of the round

5.8.1.83. The rice quantity shall be measured before the round and shall be the same for all teams in the same competition stage.

Table Layout

5.8.1.84. The source container and target bowl shall be placed on the competition table in predefined marked start zones.



5.8.1.85. The source container shall begin upright and filled with rice.

5.8.1.86. The bowl shall begin upright and empty.

Required Task

5.8.1.87. The robot shall:

- grasp and control the source container with one arm
- grasp, hold, or stabilize the target bowl with the other arm
- pour the rice from the source container into the target bowl
- complete the task without prohibited human intervention

5.8.1.88. The bowl may be lifted, repositioned, or held during the pouring action.

5.8.1.89. The source container and bowl shall both end the round upright or in a stable resting position.

Meaningful Two-Arm Requirement

5.8.1.90. For this round:
- one arm shall control the source container during the pour
- the other arm shall control, hold, reposition, or stabilize the bowl during the pour

5.8.1.91. A run shall not receive full task credit if the bowl remains untouched for the entire pouring action.

Time Limit

5.8.1.92. See section 5.8.2.

Completion Condition

5.8.1.93. The round shall be considered complete when:
- the robot signals completion, or
- the time limit expires

Scoring

5.8.1.94. Maximum score for Round 1: 100 points

5.8.1.95. Scoring Breakdown

A. Successful transfer into bowl: up to 60 points

- 60 points if at least 120 g of rice is in the bowl at the end of the run
- 45 points if 100 g to 119 g is in the bowl
- 30 points if 80 g to 99 g is in the bowl
- 15 points if 50 g to 79 g is in the bowl
- 0 points if less than 50 g is in the bowl

B. Spillage control: up to 20 points

- 20 points if spilled rice outside the bowl is 10 g or less
- 15 points if spill is 11 g to 25 g
- 10 points if spill is 26 g to 40 g
- 5 points if spill is 41 g to 60 g

- 0 points if spill exceeds 60 g

C. Meaningful two-arm coordination: 10 points

- 10 points if both arms are used clearly and meaningfully during the transfer
- 0 points if the task is effectively completed with one arm only

D. Time bonus: up to 10 points

- 10 points if completed in 45 seconds or less
- 8 points if completed in 46 to 60 seconds
- 6 points if completed in 61 to 75 seconds
- 4 points if completed in 76 to 90 seconds
- 2 points if completed in 91 to 120 seconds
- 0 points if not completed within time

Penalties

5.8.1.96. The following penalties shall apply:

- minus 10 points if the bowl is overturned at any time
- minus 10 points if the source container is dropped and cannot be recovered
- minus 5 points for each object pushed completely outside the active workspace
- minus 10 points for unsafe or uncontrolled motion, at the judges' discretion

5.8.1.97. The total round score shall not be reduced below zero.

Round 2 – Folding

Robots must coordinate two arms to fold a set of cloth items according to the required fold pattern.

Objective

5.8.1.98. The robot shall use two robotic arms to fold a specified number of cloth items according to the required fold pattern and place the folded items in the designated target area.

Competition Objects

5.8.1.99. The following objects shall be used:

- 1 light blue cloth
- 1 light green cloth
- 1 light yellow cloth
- 1 light pink cloth

For reference, the below shows a photo of the cloths that shall be used in the competition.

Standard Object Specification

5.8.1.100. Each cloth shall be:

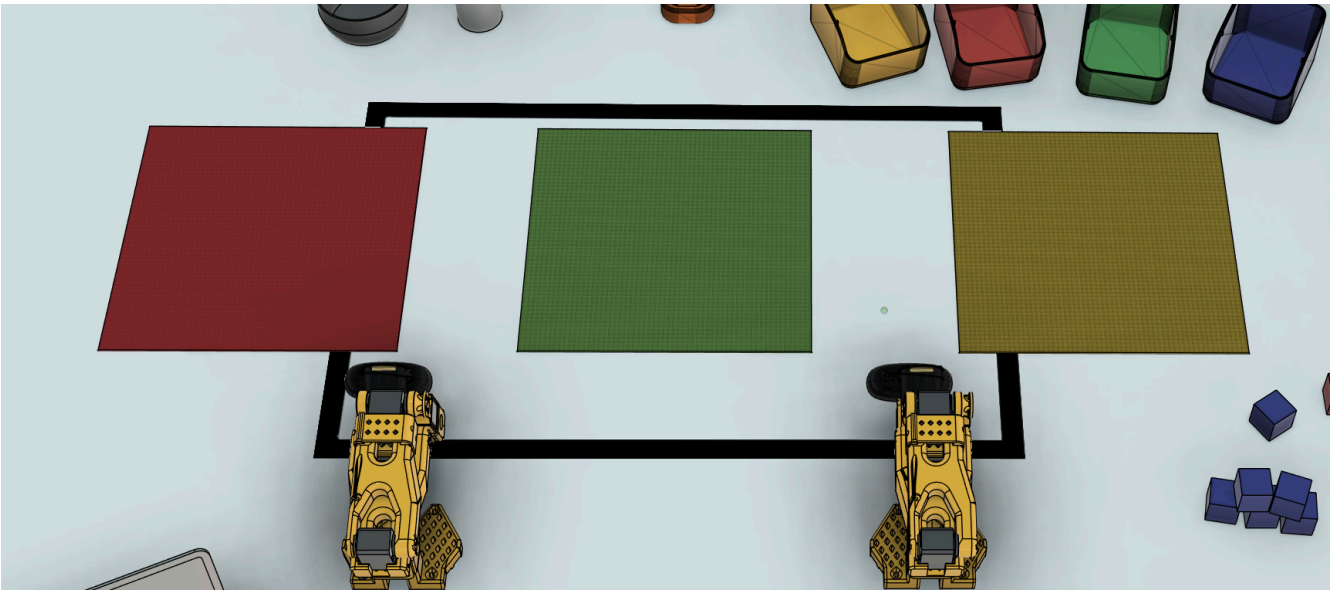
- square
- dimensions: 300 mm x 300 mm
- material: 100% polyester *(also referred to as microfibre cleaning cloths)*
- thickness: standard light towel or fabric napkin thickness
- color: solid, non-reflective, high-contrast against the table

Initial Positioning

5.8.1.101. The cloths shall be placed flat on the table in predefined start zones.

Table Layout

5.8.1.102. The four cloths shall be laid out next to each other in no specific order.



5.8.1.103. Each cloth shall begin fully unfolded and approximately centered in its start zone.

Target Placement Zone

5.8.1.104. The target placement zone for folded cloths shall be:
- Within the rectangular area marked with a black boundary
- Folded cloths completely within the boundary
- Folded cloths may be next to each other or stacked

Required Fold Pattern

5.8.1.105. Each cloth shall be folded in two stages:
- first fold: fold in half along one axis to form a rectangle
- second fold: fold in half again along the longer axis to form a smaller rectangle

5.8.1.106. Final expected approximate size:
- 150 mm x 150 mm, with tolerance as defined below

5.8.1.107. The same fold pattern shall apply to all three cloths.

Required Task

5.8.1.108. The robot shall:
- manipulate each cloth using two robotic arms
- perform the required two-stage fold for each cloth
- place the folded cloths within the target placement zone

Meaningful Two-Arm Requirement

5.8.1.109. For each cloth, both arms shall contribute meaningfully to the folding process through grasping, aligning, tensioning, repositioning, or flattening.

5.8.1.110. A cloth folded using only one arm shall not receive full completion credit.

Time Limit

5.8.1.111. See section 5.8.2.

Completion Condition

5.8.1.112. The round shall be considered complete when:

- all three folded cloths are placed in the target zone and the robot signals completion, or
- the time limit expires

Scoring

5.8.1.113. Maximum score for Round 2: 100 points

5.8.1.114. Scoring Breakdown

A. Fold completion: up to 45 points

- 15 points for each cloth correctly folded into the required two-stage form

A cloth shall be considered correctly folded if:

- it shows two distinct fold actions
- it is visibly reduced to the expected folded form
- it is not significantly twisted or crumpled

B. Fold quality and alignment: up to 30 points

- up to 10 points per cloth based on edge alignment and neatness

Per cloth:

- 10 points if the edges are aligned within 20 mm
- 7 points if aligned within 35 mm
- 4 points if aligned within 50 mm

- 0 points if misalignment exceeds 50 mm or the fold is not judgeable

C. Target zone placement: up to 15 points

- 5 points per cloth if fully inside the target placement zone

D. Meaningful two-arm coordination: 5 points

- 5 points if both arms are used meaningfully across the round
- 0 points otherwise

E. Time bonus: up to 5 points

- 5 points if completed in 90 seconds or less
- 4 points if completed in 91 to 120 seconds
- 3 points if completed in 121 to 150 seconds
- 2 points if completed in 151 to 180 seconds
- 0 points if not completed within time

5.8.1.115. Penalties

The following penalties shall apply:

- minus 5 points per cloth dropped fully outside its work area
- minus 5 points per cloth that unfolds before the validation period ends
- minus 10 points if folded cloths are stacked in a way that prevents judging
- minus 10 points for unsafe or uncontrolled motion, at the judges' discretion

5.8.1.116. The total round score shall not be reduced below zero.

Validation Period

5.8.1.117. At the end of the run, the folded clothes shall remain stable for 5 seconds to be accepted.

Round 3 – Wrap and Pack

Robots must coordinate two arms to wrap an object, place it into a box, and close the box to complete the packaging task.

Objective

5.8.1.118. The robot shall use two robotic arms to wrap an object in the provided wrapping material, place the wrapped object inside a cardboard box, and close the box.

Competition Objects

5.8.1.119. The following objects shall be used:

- 1 rigid object (**3-e Robot Mascot**)
- 1 bubble wrapping sheet
- 1 cardboard box

5.8.1.120. Object:

- Shape: **3-e Robot Mascot for the Robot Championship**
- Dimensions: **150mm tall**
- Smooth outer surface

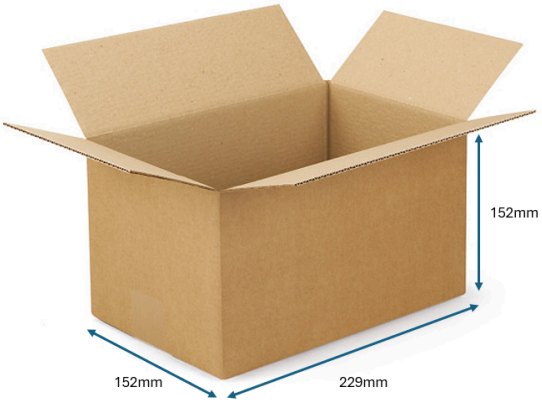
The 3-e Model files for 3d printing are available on the web site. Print in PLA

5.8.1.121. Wrapping material

- 1 square sheet
- dimensions: **400 mm x 400 mm**
- material: bubble wrap

5.8.1.122. Cardboard box

- rigid foldable or pre-formed box
- dimensions: **229 mm x 152 mm x 152 mm**
- top flaps designed to close without tape
- same model and material for all teams



Initial Positioning

5.8.1.123. The object, wrapping material, and box shall be placed in a predefined start zone in front of the robot arms.

Table Layout

5.8.1.124. The wrapping sheet shall start flat on the table.

5.8.1.125. The object shall start resting separately from the wrapping sheet.

5.8.1.126. The box shall start open and empty.

Required Task

5.8.1.127. The robot shall:
- manipulate the object and wrapping material
- wrap the object using the provided wrapping sheet
- place the wrapped object fully inside the box
- close the box flaps fully

5.8.1.128. The robot may choose its own sequence, provided the object is wrapped before being placed into the box.

Wrapping Requirement

5.8.1.129. For this round, an object shall be considered wrapped if:
- the wrapping material covers at least 70% of the object surface area, and
- the wrapping remains around the object when it is placed into the box

5.8.1.130. Perfect symmetry or gift-style presentation shall not be required.

Box Closure Requirement

5.8.1.131. The box shall be considered closed if:
- all top flaps are folded into their final closed positions, and

- no part of the object protrudes outside the box

5.8.1.132. Tape, glue, or fastening shall not be required.

Meaningful Two-Arm Requirement

5.8.1.133. Both arms shall contribute meaningfully during the wrapping and packing process through object handling, sheet handling, alignment, insertion, or box closure.

Time Limit

5.8.1.134. See section 5.8.2.

Completion Condition

5.8.1.135. The round shall be considered complete when:
- the object is wrapped, boxed, and the box is closed, and the robot signals completion, or
- the time limit expires

Scoring

5.8.1.136. Maximum score for Round 3: 100 points

5.8.1.137. Scoring Breakdown

A. Wrapping completion: up to 30 points

- 30 points if wrapping covers at least 70% and remains on the object
- 20 points if wrapping covers 50% to 69%
- 10 points if wrapping covers 30% to 49%
- 0 points if coverage is below 30%

B. Placement into box: 20 points

- 20 points if the object is fully inside the box
- 10 points if partially inside but not fully contained
- 0 points if not placed in box

C. Box closure: 25 points

- 25 points if all flaps are fully closed
- 15 points if major flaps are closed but minor flaps remain open
- 5 points if box is partially closed
- 0 points if left open

D. Meaningful two-arm coordination: 10 points

- 10 points if both arms are clearly used meaningfully
- 0 points otherwise

E. Final packed stability: 5 points

- 5 points if the final packed state remains stable for the validation period
- 0 points otherwise

F. Time bonus: up to 10 points

- 10 points if completed in 120 seconds or less
- 8 points if completed in 121 to 150 seconds
- 6 points if completed in 151 to 180 seconds
- 4 points if completed in 181 to 210 seconds
- 2 points if completed in 211 to 240 seconds
- 0 points if not completed within time

5.8.1.138. Penalties

The following penalties shall apply:

- minus 10 points if the object is dropped and not autonomously recovered
- minus 10 points if the box is overturned and not restored
- minus 5 points if wrapping material is torn due to uncontrolled motion
- minus 5 points for each object pushed outside the active workspace
- minus 10 points for unsafe or uncontrolled motion, at the judges' discretion

- minus 10 points if object is broken during handling
- minus 10 points if box is torn

5.8.1.139. The total round score shall not be reduced below zero.

Validation Period

5.8.1.140. At the end of the run, the closed box shall remain stable and closed for 5 seconds.

5.8.2. Game Timing

5.8.2.1. The table below shows an indicative timing for each round and game. Timings are subject to change.

5.8.2.2. The judges may decide to modify the timing of the rounds and games on the competition day.

5.8.2.3. Time will be allocated for the day prior to the competition for the teams to set-up their robot arms and carry out necessary testing and celebration.

Stage	Preparation / setup	Active competition	Scoring / reset	Total duration
Opening equipment inspection and calibration	1:00			1:00
Game 1 - Round 1: Colour Sort	0:05	0:05	0:10	0:20
Game 1 - Round 2: Shape Sort	0:05	0:05	0:10	0:20
Game 1 - Round 3: Dynamic Sort	0:06	0:06	0:10	0:22
Game 1 ranking verification			0:15	0:15
Inspection and calibration between Games 1 and 2	2:00			2:00
BREAK	1:00			1:00
Game 2 - Round 1: Pouring	0:06	0:05	0:10	0:21
Game 2 - Round 2: Folding	0:05	0:05	0:10	0:20
Game 2 - Round 3: Wrap and Pack	0:06	0:04	0:10	0:20

Final leaderboard verification			0:15	0:15
Inspection and calibration before final	1:00			1:00
Tower Construction Duel		00:20	0:20	0:40
Technical and judging contingency			0:20	0:20
Competition-day total				**8:33**
Combined operational allocation over both days				**11:33**

5.8.3. Leaderboard

5.8.3.1. Points awarded in each qualification game contribute to the overall competition leaderboard.

5.8.3.2. Teams compete in three qualification games to earn points and secure a place on the overall leaderboard.

5.8.3.3. The top two teams then advance to the final, where they face off in the final game to determine the overall champion.

5.8.4. Final: Tower Construction Duel

In the final, the top two teams, each composed of a pair of autonomous robotic arms, compete to construct the tallest stable tower from a shared set of building blocks while strategically hindering the opposing team - this is the **Tower Duel**.

The Final Duel is a head-to-head robotics challenge where two teams use dual robotic arms to build the tallest and most stable tower within their own workspace, while strategically disrupting their opponent using limited resources.

The game combines:

- autonomous robotic manipulation
- human strategic input
- resource management

- controlled adversarial interaction

Each team must continuously decide:

- build higher
- reinforce stability
- or disrupt the opponent

These decisions are influenced by periodic human commands, while execution remains fully autonomous.

Objective

The objective of the Final Duel is for each team to construct the tallest and most stable tower within their designated build zone while strategically managing limited resources and applying controlled disruption to the opposing team.

5.8.4.1. This challenge emphasises collaborative manipulation, perception-driven decision-making, and robustness under interference, showcasing the extended capabilities of modern Physical AI systems.

5.8.4.2. Robotic systems shall operate autonomously, with limited high-level human strategic input.

5.8.4.3. Each team must coordinate internally while adapting to adversarial actions in a dynamic, shared physical environment.

5.8.4.4. During the challenge teams may interact with their robotic system using natural language commands to influence high-level strategy. This interaction is limited to strategic guidance, such as task prioritisation, role allocation, or tactical intent, and must not involve direct low-level control or real-time manipulation commands. The robotic arms must autonomously interpret the intent of the natural language input and execute actions independently through their learned policies.

This capability is intended to demonstrate human–AI collaboration, language-grounded decision-making, and the integration of symbolic intent with physical execution.

Competition Format

5.8.4.5. The Final shall be contested between the top two (2) ranked teams.

5.8.4.6. Each team shall operate:
- two (2) robotic arms
- one (1) human operator

5.8.4.7. The match shall be conducted in a shared arena with two separate build zones.

5.8.4.8. See section 5.8.2.

Layout

5.8.4.9. The arena shall consist of two clearly defined build zones positioned opposite each other.

5.8.4.10. Each team shall operate exclusively within its assigned build zone.

5.8.4.11. Both build zones shall have identical dimensions and shall use a white surface for consistency and perception simplicity.

Objects and Materials

5.8.4.12. All objects used in the Final Duel shall:
- be based on official 3d printed cube blocks (organizer-provided STL designs)
- shall have consistent geometry, size tolerances, and material properties.
- there will be blue blocks and red blocks only

5.8.4.13. **Blue Blocks** — Construction Objects
- Used exclusively for construction.

- Be stackable
- Provide structural stability
- Shall not be thrown
- Shall not be dropped intentionally for disruption
- Shall not be used for impact-based interference

5.8.4.14. **Red Blocks** — Dual-Use Objects
- May be used for construction
- May be used for controlled throwing for disruption
- Teams shall decide how to allocate red blocks during the match.
- Red blocks may be reused after recovery.

5.8.4.15. Any red block that is thrown and comes to rest within the opposing team's reachable zone may be recovered by that team.

5.8.4.16. A recovered red block may be used for:
- Construction
- or future throwing

5.8.4.17. A block shall be considered recovered when:
- it is grasped
- and brought under controlled manipulation

5.8.4.18. Blue blocks shall not be used for throwing under any circumstances.

Autonomous Operation

5.8.4.19. All robot actions shall be executed autonomously.

5.8.4.20. Robots shall:
- perceive the environment
- select objects
- plan actions
- execute manipulation

5.8.4.21. Direct human control of robot motion is strictly prohibited.

Human–AI Strategic Interaction

5.8.4.22. Each team may provide high-level strategic input to the robot system.

5.8.4.23. The team that uses the least amount of interactions / commands will have a score advantage during this game.

5.8.4.24. Commands may be given:
- within a defined command window

5.8.4.25. Commands must:
- express intent only
- not specify exact movements or coordinates

Examples of valid commands

"prioritize height"

"reinforce the base"

"use a red block"

Throwing and Disruption

5.8.4.26. Blocks can be thrown to the opponent only when the tower is at least 6 blocks high. This is applicable throughout the challenge.

5.8.4.27. Only red blocks may be thrown.

5.8.4.28. Throwing shall be performed using controlled robotic motion only.

5.8.4.29. A maximum of one (1) throw is allowed per command interval.

5.8.4.30. Rapid or repeated throwing actions within the same interval are prohibited.

Prohibited Actions

5.8.4.31. The following are strictly prohibited:
- use of launch mechanisms (springs, catapults, etc.)
- uncontrolled dropping from height
- deliberate high-force impact actions
- causing instability of the platform/table

5.8.4.32. Throws shall be directed toward the interaction zone specifically at the opponent's tower.

Structural Stability

5.8.4.33. A tower shall be considered valid only if it remains stable and self-supporting.

5.8.4.34. Stability shall be evaluated:
- at the end of the match
- and after any disturbance

5.8.4.35. A structure must remain stable for a minimum of five (5) seconds to be considered valid.

Scoring

5.8.4.36. Scoring shall be based on the following:
- **Tower Height (Primary)** measured from base to highest stable point
- Structural Quality including alignment, balance, efficient use of objects

5.8.4.37. If a blue block is thrown to the opponent a point will be deducted.

5.8.4.38. If a block is thrown when the tower of the team throwing the block is less than 6 blocks high, a point will be deducted.

Controlled Manipulation Requirement

5.8.4.39. All object interaction shall be:
- Controlled
- Deliberate
- executed via the robotic gripper

5.8.4.40. Throwing, placement, and recovery must not:
- introduce unsafe motion
- create uncontrolled object behavior

Safety and Fair Play

5.8.4.41. Teams shall not:
- interfere with opponent hardware
- cross into the opposing build zone

5.8.4.42. Any unsafe or abusive behavior may result in penalties or disqualification as deemed fit by the judges.

6. MAINTENANCE WORKSHOP (PIT AREA)

6.1. Power tools are permitted on the day(s) of the event. Care must be taken not to damage any property. Any damage done to the premises will have to be paid for by the offending team.

6.2. If you require batteries from the organiser, you must inform them no later than 30th September 2026. We will only provide specific batteries as listed by the organisers against a fee. Robots must be designed to support these types of batteries and you will need to get your own chargers for these batteries. For more details, please contact the organisers.

6.3. No welding equipment is allowed on the premises.

6.4. Only repairs may be carried out in the workshop. Modifications to the robot are prohibited after the final technical checkup.

6.5. A staff member will notify teams ten (10) minutes prior to their game so that any repairs and adjustment can be safely finalised. If a team does not approach the arena in time, the jury is empowered to disqualify the team for that game.

6.6. A maximum of three (3) persons per team is allowed in the maintenance workshop.

7. ‘MAKING OF’ MATERIAL

7.1. Each team must submit a ‘making of’ video of the robot two weeks prior to the actual competition. These videos will be used to promote the competing robots in between games.

7.2. Submission of the video is COMPULSORY. Failure to produce such material will result in a subtraction of points for the team in the Qualifying phase.

7.3. The video must be submitted by 1st November 2026. The music used in the video must be licensed. You must provide us with the music and its licence by 30 September 2026. The video needs to be created showing “in the making” using health safety approach when using the tools to build the robot for both categories.

7.4. The video must include a background of the team members as well as the specifications of the robot to be submitted.

7.5. The video must be at least three (3) minutes and not longer than ten (8) minutes long.

7.6. Each individual video will have points allocated to it as deliberated by the organising committee.

8. SUBMISSION DETAILS

8.1. The competitors will be asked to hand in their robots at a specified date before the competition, generally one day prior to the competition itself. No robot will be allowed to participate if not delivered by this date irrespective of the reason produced.

8.2. Teams are required to register their robot on Friday, the XX November 2026, at 16:00 at the venue where the championship will take place.

8.3. When handing the robot to the organisation, robots will be measured and weighed to make sure they abide by the rules.

8.4. An inventory sheet will be prepared by the organisation and delivered for completion to each team in order to list any additional items the robot will use during the event. Examples for these items are extra body panels, add-ons and batteries. Participants will only be allowed to use the items declared on this day during the competition. This inventory sheet must be filled and submitted to the organisation at least one day prior to the competition start.

8.5. Competitors will also be requested to display the robot in operation to the organisers, subsequent to which competitors will only be allowed to remove batteries for charging.

8.6. The batteries will be marked by an IEEE official in order to ensure that no other batteries are used during the event. Following this, the robot shall be held in the possession of the organisation until the day of the tournament, preferably in a locked up sports bag or any other contraption.

9. DISCLAIMER

9.1. The IEEE Region 8 (henceforth referred to as “we”) reserves the right at any time and at our sole discretion, to make any changes to the rules and regulations without prior notice.

9.2. We reserve the right to disqualify any robot that, in our sole opinion, is likely to damage the premises or compromise the safety of any personnel, contestants and members of the general public.

9.3. In order for the Robot Championship to be held, at least ten (10) teams must register. Should one or more teams drop out after the registration period, the championship will still take place provided that at least six teams (6) submit a functioning robot for that particular category on the submission date.